



Delivering World-Perfect Pizzas with Ingredient Innovation

How to give the world a better tasting, better for you pizza with naturally sourced, tomato-based taste, texture and color ingredients.



Welcome to planet pizza

Global consumption of the world's most popular food combination is expanding at an exponential rate. To capture a larger slice of this diverse and fast-growing pie, pizza industry leaders are quickly responding to consumer dietary and regulatory trends with fresh recipe and ingredient innovation. However, as markets grow, and tastes and regulations change, every segment of the pizza industry is being challenged to deliver more authenticity and taste with less salt and sugar and zero artificial ingredients.

It's a big pie, after all

The global market for pizza is enormous and consumption is growing rapidly especially among people in countries with little cultural or dietary association with the dish. According to Research and Markets, the worldwide pizza market is projected to reach \$233.26 billion by 2023 and expected to grow at a compound annual growth rate (CAGR) of 10.17%, for the period.¹ Given the size and potential of the global pizza market, it is no wonder that the most prominent companies in prepared foods want to try and order themselves an extra-large share of the market.

Pizza value chain growing longer and colder

What's true for the pizza industry and every enterprise along its complex value chain is the fact that the companies supply chains are growing both longer and more geographically complex. That factor alone will continue to challenge the industry as it tries to maintain product integrity from one end of their supply chain to the other.

According to Technomic's 2018 Pizza Consumer Trend Report, 83% of U.S. consumers eat pizza at least once every month, and 43% of Americans eat pizza at least once a week.² With more than 95,000 pizza outlets across the country, new frozen varieties at grocery stores and prepared offerings in convenience stores, consumers have growing access to more pizza choices.



The not-so-frozen market for frozen pizza

Frozen pizza sales are baking up new profits for prominent makers. The global frozen pizza market size was valued at \$19.6 billion in 2019 and is expected to grow at a CAGR of 3.2% from 2020 to 2027.³

Commercial pizza makers understand color is one of the things that sell a pizza most and the red sauce must be there, shining through, ready for savoring along with the toppings and cheese if that is on the menu.

Sauce color must present like it was ladled straight out of the pot and onto the dough. It then must stay robust and the color stable throughout every phase of distribution, retailing, and consumption. Therefore, the stability, the color integrity of pizza sauce in particular – in all formats – is essential to the increasing demand for these products with consumers, and the key to their ultimate market success.

The focus on healthier choices in frozen prepared foods has mainly come in the form of replacing artificial ingredients and preservatives with more natural ones. In the Nielsen report “It’s Clear: Transparency Is Winning in The U.S. Retail Market,” the study revealed **68% were willing to pay more for foods and beverages that didn’t contain ingredients perceived as bad for them.**⁴

When it comes to making claims about natural color ingredients Nielsen’s study found food producers might be missing out on a real opportunity. Nielsen data showed that only 7% of the products that don’t include artificial ingredients make the effort to denote this attribute on their product packaging.

What is true is that relative to all commercial pizza categories the market for frozen and refrigerated pizza is delivering financial results. Recipe and ingredient innovation in this category is very dynamic with new products and pizza combinations hitting market shelves every day.^{5,6,7}

Naturally sourced color ingredients, especially lycopene from Lycored, can assure that the color integrity of tomato sauce withstands the rigours of a longer, more complicated supply chain and the need to maintain color more reliably over the entire expected shelf life of the product.

Those who explicitly mention all ingredients are natural, including color Nielsen reports, saw a nearly 6% increase in dollar sales, an estimated \$18 billion for the year ending April 29, 2017.



Fade to a paler shade of orange

At the heart of any pizza is the sauce which for most pizzas, is red and made from tomatoes. For most frozen pizza purveyors maintaining robust sauce color longer is extremely important. If pizza sauce colors aren't authentic and vibrant at the point of purchase that purchase may occur elsewhere.

Color in frozen pizza is prone to turning from red to pale orange over the course of its shelf life. Typically, this occurs over a period of about six months in cold storage. Once a pizza reaches retailers the process can accelerate from the myriad site variables that can fade sauce color, and ultimately curtail the product's shelf life.

How naturally sourced Lycopene extends pizza shelf life

Lycored researchers and food scientists wanted to evaluate if adding their lycopene based colors to pizza sauce could improve color stability over the shelf life of a frozen pizza with and without mozzarella cheese.

Conducted in real time and under controlled conditions, pizzas with and without mozzarella cheese underwent color analyses at defined test points over a potential frozen pizza shelf life (1 year).



Color screening

- Evaluate color shades across dosages and target color reference



Replicate full production methodology

- Ingredients, blending, dispersing, with & without mozzarella, packaging & freezing



Replicate shelf life (real time)

- Standard retail storage (frozen)



Testing and evaluation points

- 12 months, time points: T0, T1, T3, T6, T9 & T12.



Color analysis

- Color Flex, L*a*b
- Delta E for color change
- Photographic imagery under standardized lighting (Daylight)
- Pantone

Test conditions



Standard conditions -25°C



Real time study span of 12 months

Definitions

Delta E (DE or ΔE) values indicate how much a standard and sample differ from one another in L, a and b (Delta=total color difference)



Difference not perceived with eyes



Slight difference



Visible difference

Superstable lycopene to the rescue

Although tomatoes naturally contain lycopene, the levels in commercial tomato paste are not in a stable format to maintain color. All Lycored superstable reds are based on lycopene from tomatoes and formulated for superior stability in a range of pH conditions, heat, and light. Made from the company's own bespoke tomatoes, Lycored's color ingredients for pizza sauce are proven by science and tested for stability across multiple applications.

Initial shelf life trials at Lycored have demonstrated that the addition of lycopene (ResilientRed A) in frozen pizza improves the color stability over shelf life without the need of an antioxidant such as Ascorbic Acid.

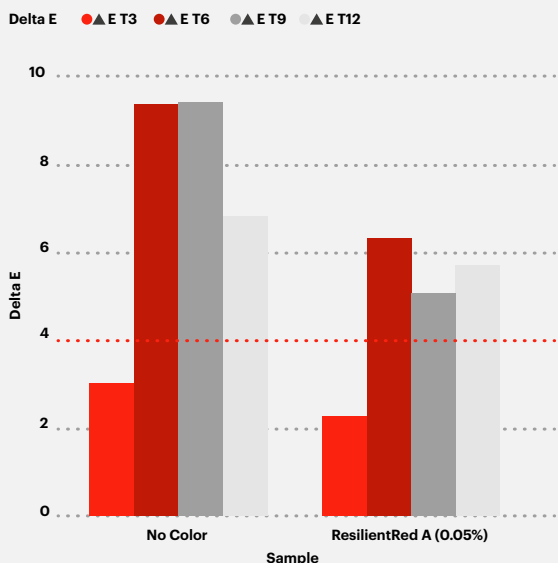
Minimum inputs, maximum results

Results reveal that with no color added, the pizza sauce shows significant color change after only three months and continues to change over shelf life. Additionally, scientists concluded that ResilientRed A at 0.05% is recommended for pizzas with no mozzarella and ResilientRed A at 0.1% is recommended for pizzas with mozzarella.

With Lycored superstable colors, color change is significantly delayed by about six months and helps maintain the original visual appearance of pizza sauce over shelf life. The bottom line is that lycopene based colorants from Lycored can be used in frozen pizza to extend shelf life thus reducing reclamation costs.

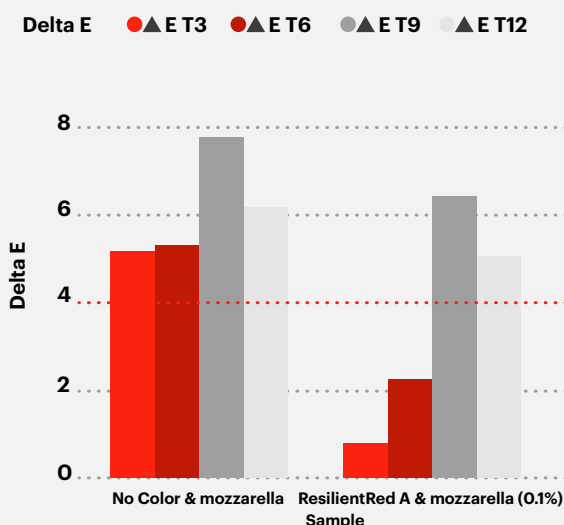
ResilientRed A (0.05%)

Evaluation of color in pizza sauce - no mozzarella



ResilientRed A & mozzarella (0.1%)

Evaluation of color in pizza sauce with mozzarella



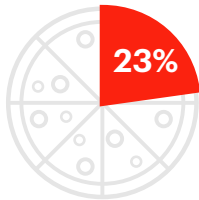
Benefits of naturally sourced color and stability with Lycored

Lycopene offers food scientists a long value proposition:

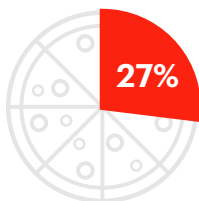
- **Authentic, long lasting, stable fresh tomato sauce color.**
- **Shows significant color offset which continues over shelf life.**
- **Color change is significantly delayed by about 6 months.**
- **Extends color shelf life reducing restocking and reclamation costs.**
- **Naturally sourced from tomatoes.**
- **Meets kosher, halal, vegetarian, vegan, and non-GMO requirements.**
- **Great for conventional, vegetarian, and vegan pizzas.**

Lycopene is not permitted in pizza sauce in all regions. Please check regulatory guidelines.

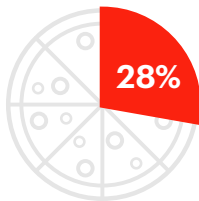
Technomic's Pizza Report shares what consumers want



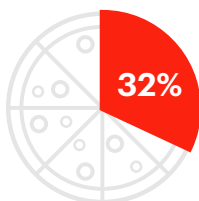
23% are interested in gluten-free pizza options



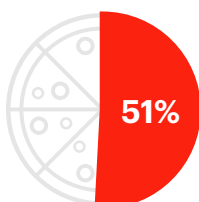
27% are interested in low-carb pizza options



28% strongly agree they would eat pizza more often if there were healthier options



32% want restaurants to offer pizzas made with organic ingredients



51% would like more restaurants to offer pizzas made with natural ingredients

Flavor, ingredient diversity and product innovation will dominate

Prepared food and pizza market analysts agree taste will continue to define the international pizza landscape, with bolder and more ethnically oriented flavors tempting more pizza lovers around the world to bite.

Recipe innovation is at the forefront of product development and to win new hearts and wallets, traditional combinations (pepperoni or sausage) are being superseded by new meat combinations, as well as creative vegetable crusts, sauces, plant-based toppings and other natural ingredients and spices sourced from the world's cuisines.

As always, convenience, comfort and immediate gratification will play a critical factor in these purchases, but "better for me" and "a better choice for the kids" are the new caveats that will win future sales with most old and new pizza lovers. Consumers will be looking for products differentiated as a healthier choice but need to know up front that the pizzas they buy contain higher quality, naturally sourced ingredients.

Meeting the world's growing consumption of pizza offers prepared food manufacturers and developers, tremendous opportunity. But even though the format is relatively simple to produce, and the food/ingredient processing at commercial scale generally well understood, the industry will be increasingly challenged to overcome the growing complexities of delivering pizzas to the planet that are healthier – as in organic, natural, clean label and transcend a range of dietary norms.

Diets are changing, pizzas are changing too

Vegetarians, for example, used to be associated with societal or religious norms but today the reasons for making this dietary choice have more to do with personal lifestyle and health-based reasons. Regarding pizza, most primary ingredients are already plant-based and with the availability of vegan cheese and plant-based meats, potentially all toppings can be too.

Technomic's 2020 data finds plant-forward options are on the rise, even among consumers who don't abstain from eating meat or animal products. Another trend that continues to make waves is gluten-free.⁸ Although people may not identify themselves as 'vegetarian' or 'vegan', the dietary ethos has carried over to more consumers who eat less meat- these folks are known to food marketers as "flexitarians."

Too much added sugar, too much salt in pizza

Although a common ingredient in commercial pizza sauce and dough recipes, the amount of sugar and salt in processed foods has come under increased scrutiny by regulators because it has the potential to become a significant portion of peoples' diets and recommended allowances without them realizing.

A recent report from Mintel "Salt and Sugar Levels in Pizza Will Face Scrutiny," explains that the pandemic refocused attention on "minus" or negative claims as consumers reevaluate the importance of personal health. As a result, say Mintel's researchers, there will be increased pressure on brands to reduce sugar, salt, and calorie levels in indulgent products such as pizza.⁹



Invest in sugar replacements

Sugar has increasingly been associated with obesity and diabetes; two diseases that lead to increased mortality and rising public healthcare costs. In the face of public outcry, health organizations such as the World Health Organization (WHO) have been vocal about the need to moderate sugar intake and many governments have responded with regulatory measures, placing levies on products with high sugar content.¹⁰

Despite evolving diets and public opinion, consumption of added sugar and other sweeteners continues to rise globally. Sugar and sweeteners are intrinsic to many products and though medical reasons have moved certain consumers away from sugar, many are changing their attitudes based on less quantifiable reasons. More than half those responding to a Euromonitor study found eating less sugar “makes me feel healthier” and nearly as many responded they had “read or heard that a low sugar diet is good for me.”¹¹

Mintel notes that the war on sugar, and disruptor brands offering low-sugar claims, will challenge major pizza brands to be more proactive and transparent about sugar levels. Alternate ingredient strategies including rare sugars and pending sugar reduction technology offer potential to food scientists, explains Mintel.

Low-sodium pizza planet

High sodium intake is estimated to cause approximately 3 million deaths per year worldwide. The estimated average sodium intake of 3.95 g/day far exceeds the recommended intake.

A study published by the National Institutes of Health (NIH) looked at high priority strategies to address major sources of sodium added to packaged food, added to food consumed outside the home and added in the home. They found that generally, pizza alone can help to contribute to one-third of a person’s daily sodium intake.¹² According to the FDA, population sodium reduction is becoming a global priority.

For example, the European Salt Action Network (ESAN) was established under the auspices of WHO and the support of the United Kingdom Food Standards Agency (FSA) to promote the harmonization of salt intake reduction programs in EU countries. The primary goals of ESAN include establishing a network of countries committed to reducing salt intake and building international action on salt reduction. So far, Switzerland leads the 23-country network, with WHO/Europe and the European Commission participating as observers.¹³



Searching for sodium alternatives

Pizza chefs are getting creative in trying to increase the apparent saltiness in foods by heightening the umami flavor profile says Jeff Zeak, a pilot plant manager for the American Institute of Baking (AIB).¹⁴ Umami, a Japanese word meaning “savory,” refers to the final member of the five basic tastes including sweet, sour, bitter and salty—that can be detected by the human tongue. Monosodium glutamate (MSG), inosine monophosphate (IMP) and guanosine monophosphate (GMP) all create the umami flavor.

The umami-boosting capabilities of those compounds is synergistic and, Zeak notes, can provide more flavor profile impact when combined than when used alone. Further, consumers have a negative perception of MSG and high levels have been known to create problems for some digestive conditions.

Ingredients that are naturally high in umami flavor, notes Zeak, include autolyzed yeast extracts (AYE), hydrolyzed vegetable proteins (HVP), meat pastes, savory broths, Parmesan cheese, mushrooms, tomatoes, reduced-sodium soy sauce and ‘concentrated tomato serums’.

Lycored offers both SANTE and CTC as part of their Real Food Ingredients portfolio from the company’s highly cultured tomatoes. Both are non-GMO and can be declared as either ‘tomato concentrate’ or ‘natural flavor’ depending on local regulations. SANTE is a taste-enhancing solution that allows a reduction in sodium from salt by 30% to 65% in some applications. Available in a liquid or powder format, it is a reliable commercial solution for removal of MSG, yeast extracts, or artificial flavors while giving taste a great boost. CTC is a liquid serum that harnesses the balance of acidity and high Brix sweetness of tomatoes to bring smoothness and complexity to savory products.

Benefits of naturally sourced SANTE/CTC from Lycored

Concentrates of pure tomato allow pizza makers to improve taste, quality and authenticity of pizzas with superior ingredients while extending value with:

- Sourced from tomatoes, the core base for pizza sauce.
- A natural, taste enhancing solution with well-rounded notes that deliver a balance in taste and boosts authentic tomato notes.
- Great for new product development in vegetarian and plant-based options.
- Works well for gluten-free crusts.
- Magnifies and amplifies Umami and Kokumi effects.
- Umami taste from SANTE can be leveraged to impart authentic flavor and a secure salt reduction strategy.
- Ideal for a variety of sauces from red to white.
- Sustainably sourced ingredients and clean label transparency.
- From seed to shelf 100% full supply chain (sustainability).
- Proven umami and kokumi enhancer in both dough and sauce.

Labeling food and pizza's nutritional value

Since the early 1970's when more scientific information became available on the relationship between diet and health, consumers have been eager to know what nutritional value their food contains.¹⁵ This desire for knowledge and the ability to make health-conscious dietary decisions has only continued to grow as evidenced by today's clean label and better for you health trends.

Aided by the introduction of more in-depth, easier-to-understand nutritional labeling on food packaging (such as the traffic-light system that has been adopted in varying degrees throughout the UK and the EU and the Nutrition Facts Panel in the US), consumers around the world can now easily determine the levels of calories, fat, sugar, protein, sodium, etc., that each serving of food contains, giving everyone the power to make more informed decisions about the foods they eat.^{16,17}

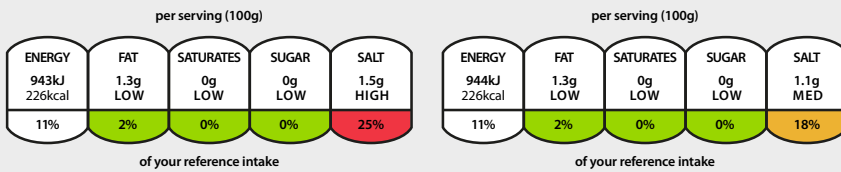
SANTE helps put crust and sauce on a reduced salt and sugar diet

Lycored evaluated how the addition of SANTE, with the reduction of salt and added sugar, stacked up in the pizza crust and sauce nutritional without affecting the taste of a typical formulation for each.

Ultimate crust control with SANTE

The Control: Salt in a typical crust recipe

The test: Adding 1% SANTE allows for a 30% reduction in salt:



Nutrition labeling from the UK clearly shows the reference intake per serving for salt, changes not just in number, 25% to 18%, but also in color, dropping from red (high) to amber (medium).

Within the US Nutrition Facts Panel, consumers can see a per-serving sodium reduction from 590 mg/26% to 420 mg/ 18%:

Nutrition Facts		
1 serving per container		
Serving size		4oz (100g)
Amount per serving		
Calories		230
% Daily Value*		
Total fat	1.5g	2%
Saturated Fat	0g	0%
Trans Fat	0g	
Cholesterol	0mg	0%
Sodium	590mg	26%
Total Carbohydrate	48g	17%
Dietary Fiber	3g	10%
Total Sugars	0g	
Includes 0g Added Sugars		0%
Protein	8g	

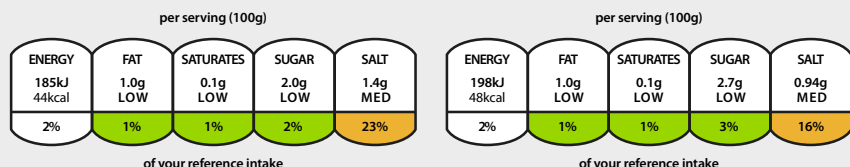
Nutrition Facts		
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Serving size		4oz (100g)
Amount per serving		
Calories		230
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Total fat	1.5g	2%
Saturated Fat	0g	0%
Trans Fat	0g	
Cholesterol	0mg	0%
Sodium	420mg	18%
Total Carbohydrate	48g	17%
Dietary Fiber	3g	10%
Total Sugars	0g	
Includes 0g Added Sugars		0%
Protein	8g	

Superb sauce control with SANTE and CTC

Lycored also evaluated the effect of adding SANTE and CTC to sauce which allowed for a 30% salt reduction and total added sugar removal.

The Control: Salt and total added sugar in a typical sauce recipe:

The test: Adding 0.46% CTC and 2.57% SANTE reduced salt 30%, and no added sugar:



Although the amber color remains the same for salt in both the control sauce and the test sauce, consumers can see a difference in the per-serving reference intake of salt reducing it from 23% to 16%.

Still well within the low level for sugar for both the control and test we see a difference in the per-serving reference rise from 2% to 3% in the UK traffic-light labels. This is due to the presence of naturally occurring sugars contained within SANTE and CTC.

Within the US nutrition facts panel, sodium decreases from 550 mg/ 24% to 370 mg/ 16%.

Nutrition Facts	
1 serving per container	
Serving size	4oz (100g)
Amount per serving	
Calories	45
% Daily Value*	
Total fat	1g 1%
Saturated Fat	0g 1%
Trans Fat	0g
Cholesterol	0mg 0%
Sodium	550mg 24%
Total Carbohydrate	3g 1%
Dietary Fiber	less than 1g 3%
Total Sugars	2g
Includes 1g Added Sugars	1%
Protein	0g

Nutrition Facts	
1 serving per container	
Serving size	4oz (100g)
Amount per serving	
Calories	50
% Daily Value*	
Total fat	1g 1%
Saturated Fat	0g 1%
Trans Fat	0g
Cholesterol	0mg 0%
Sodium	370mg 16%
Total Carbohydrate	4g 2%
Dietary Fiber	less than 1g 3%
Total Sugars	3g
Includes 0g Added Sugars	0%
Protein	less than 1g

Because SANTE and CTC’s naturally occurring sugars allow for the complete removal of the added sugar contained in the control, the US Nutrition Facts Panels show a drop from 1g added sugar per serving to 0g added sugar. Therefore, added sugars are not required and are reduced to zero, so it can be eliminated from the ingredients list.

Healthy benefits of reduced salt and sugar with real food ingredients from Lycored

- **BFY better-for-you pizzas consumers want now.**
- **Supports reduction of added sugar in pizza sauce, minimum 30% up to 100% removal.**
- **Reduces salt in pizza dough minimum 30%.**
- **Proven reformulation solution for salt and sugar reduction strategies.**
- **Promotes full salt and sugar content flavor in sauces and doughs.**
- **Eliminates declaration of sugar within pizza sauce ingredients list.**
- **Great for all conventional, vegetarian and vegan pizzas.**

Preserving texture and mouthfeel with less tomato paste

For pizza sauce recipes reducing key “structural” ingredients like tomato paste can be especially challenging. However naturally enhancing texture and mouthfeel in pizza sauce is less challenging with LycoFibers from Lycored tomatoes. Natural, and non-GMO LycoFibers provide an authentic homemade vegetable fiber effect and are an excellent method of naturally modifying pulpiness, viscosity, and mouthfeel in pizza sauces.

Benefits of reducing tomato paste in pizza sauce with tomato-based texture ingredients

- Reduce carbohydrates by reducing tomato paste.
- Reduces added tomato paste and tomato paste costs.
- Offers a smooth texture and glossy sheen to sauces.
- Allows for approximately 25% reduction in paste.
- Replaces less attractive emulsifiers (in most applications).
- Improves mouthfeel, texture and pulpiness.



Survival of the fittest: Pizza recipes adapt amidst global attitude change

Looking at all the trends driving pizza sales and consumption one thing is becoming abundantly clear: for any pizza value chain to succeed globally products must meet a growing list of consumer and regulatory expectations.

Remarking on trends driving the commercial pizza and ingredient development Dewey Warner, senior research analyst at Euromonitor International pointed to the increase of healthy attributes in pizza as a primary driver of prepared food innovation.¹⁸ In light of global trends in diet, health and fitness, the fact is, the fitter, healthier and better for you a pizza is perceived to be, the more likely it will sell.

Unlocking the natural authentic taste of your product with clean natural solutions from Lycored allows for new transparency with consumers on clean labels and sustainably sourced ingredients. Lycored natural colors and taste and texture enhancing real food ingredients provide pizza, sauce, and dough makers reliable commercial development pathways straight to the better-for-you and healthier formulations that consumers are looking for.

Endless possibilities for a better pizza

With Lycored ingredients, food scientists have new and virtually unlimited possibilities to create natural deliciousness in food. There has also never been a better opportunity to enhance the authentic taste perception and deliver the well-rounded notes, balance and overall flavor profiles pizza lovers crave.

Versatile, affordable and pizza strategy enabling, Lycored offers ingredients purpose built for the future of the pizza industry and its ongoing globalization. Lycored natural colors and real food ingredients are what bold, ingredient strategies need to meet consumer and regulatory expectations on tastier grounds, giving the industry a new passport to pizza planet.

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About Lycored

Committed to 'Cultivating Wellness', Lycored is an international company at the forefront of unearthing and combining nature's potential with cutting edge science to develop superstable natural colors and taste and texture enhancing real food ingredients for a variety of food and beverage applications. Established in 1995 in Israel, Lycored is the global leader in natural carotenoids for food, beverage, and dietary supplement products. For more information visit www.lycored.com.



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