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INTERVIEW **Mr. T. K. Radhakrishnan** Vice President – Food Systems Business Unit, HRS Process Systems Limited

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Dear Readers,

We're excited to bring you the Nov - 2026 edition of our magazine.

The food and beverage processing industry is witnessing significant changes as manufacturers increasingly embrace intelligent technologies, sustainable solutions, and innovative ingredients to stay competitive. From AI-driven production systems and advanced inspection technologies to next-generation packaging materials and evolving food formulations, innovation is creating new opportunities across the entire food value chain. The November 2026 edition of Food & Beverage Processing Magazine brings together a collection of insightful articles exploring these developments and their growing impact on the industry.

In our Processing Technology segment, we focus on how artificial intelligence is transforming food manufacturing, moving beyond conventional automation towards intelligent, predictive, and data-driven production. We explore how AI, machine learning, and connected technologies are enabling smarter process control, predictive maintenance, and improved operational efficiency. We also examine the growing importance of Intelligent Inspection and Sorting, highlighting how advanced detection and sorting systems are helping manufacturers minimise contamination, identify product defects, and maintain consistent quality and food safety standards.

Our Packaging Technology section explores the growing intersection of sustainability and packaging innovation. As the industry looks for alternatives to conventional materials, fruit waste is emerging as a valuable resource for developing bioplastics, nanocellulose, and compostable packaging solutions. We also examine the evolving coffee market and the opportunities it presents for packaging manufacturers, particularly in addressing product freshness, shelf-life requirements, convenience, and changing consumer preferences.

In the Ingredients & Additives segment, we highlight the importance of versatile ingredients and technological advancements in product development. Our feature on Fruit Puree explores its multifunctional applications in food formulation, including its contribution to flavour, texture, colour, and nutritional value across various food categories. We also look beyond conventional taste development to understand how science and technology are redefining food flavour innovation, enabling manufacturers to create distinctive sensory experiences and respond to evolving consumer demands.

Adding further value to this edition is our exclusive Corporate Interview with Mr. T. K. Radhakrishnan, Vice President – Food Systems Business Unit, HRS Process Systems Limited. In this interaction, we gain industry insights into food processing technologies, emerging market opportunities, innovation, and the evolving requirements of food manufacturers. His perspectives offer a closer look at the technologies and solutions driving progress in the food processing sector.

Alongside these features, this edition also includes updates from our corporate happenings and sustainability segments, offering insights into industry developments, business strategies, and environmental initiatives across the food ecosystem.

We also invite you to explore more insightful articles by visiting our website at www.foodnbeveragesprocessing.com

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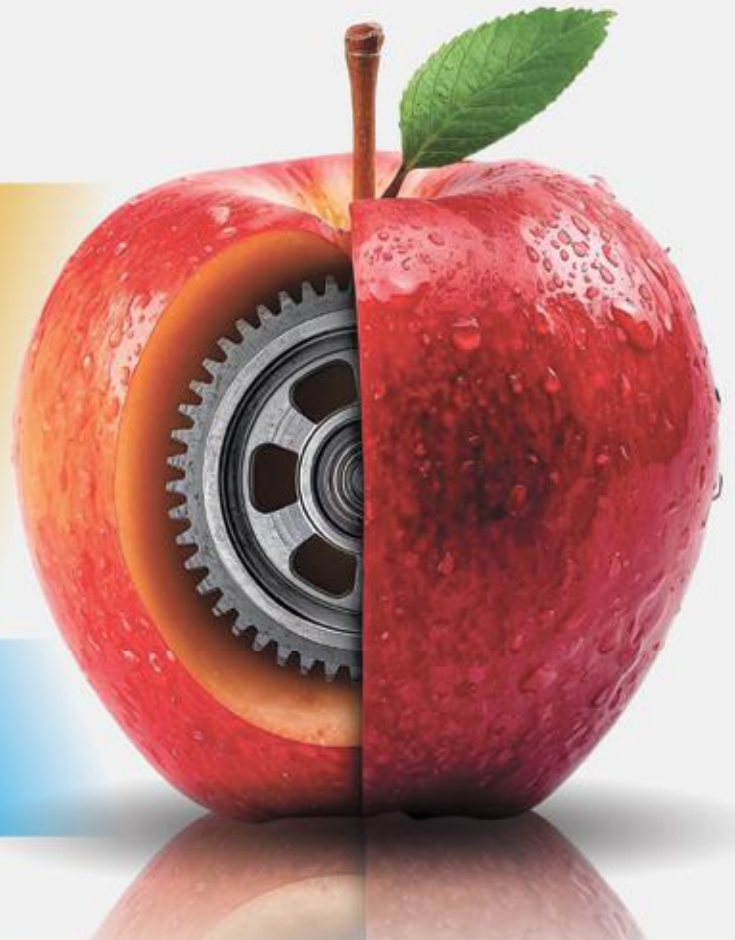
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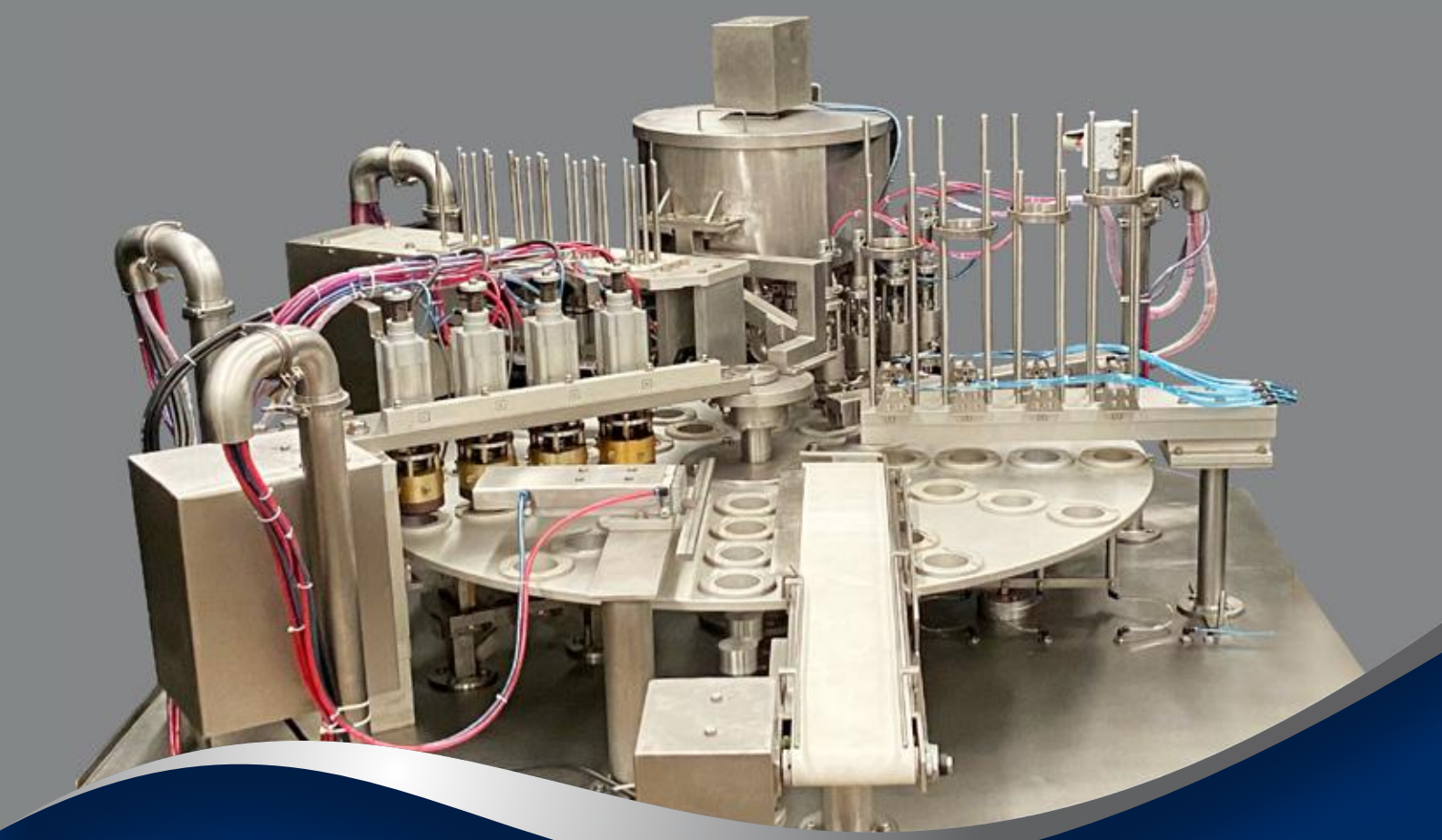
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Tata 1mg Launches Egg White Protein as an Ideal Replacement For Whey Protein



Tata 1mg has launched Egg White Protein Powder in India, offering consumers an alternative to whey protein amid rising whey prices and growing demand for dairy-free protein options. The product is aimed at fitness enthusiasts and consumers who experience discomfort with dairy-based proteins or are looking for alternative protein sources. Available in Chocolate and Cold Coffee flavours, the formulation is designed to address the traditional taste and smell associated with egg-based protein products.

Each 36 g serving provides 24 g of complete protein, equivalent to approximately seven egg whites, along with 5.6 g of branched-chain amino acids (BCAAs) and all nine essential amino acids. Naturally dairy-free and lactose-free, the product also features a five-enzyme digestive blend. Its formulation contains no added refined sugar, artificial flavours, artificial sweeteners, thickeners, anti-caking agents or preservatives. The Chocolate variant uses natural cocoa and chocolate flavour, while the Cold Coffee variant contains natural coffee flavour, with both sweetened using zero-calorie plant-based sweeteners.

To ensure product quality and safety, Tata 1mg conducts third-party testing of every batch through independent NABL-certified laboratories. The tests cover protein content and potential contaminants, including heavy metals, pesticides and banned antibiotics. Consumers can access the corresponding laboratory reports by scanning a QR code printed on the packaging.

According to Ketan Bhatia, Vice President, Tata 1mg, the product aims to provide a credible alternative for consumers who cannot comfortably consume dairy-based protein or are seeking more affordable options. The 1 kg pack is available at an introductory price of ₹2,495 against an MRP of ₹2,995, bringing the cost per 36 g serving to less than ₹90. The product is available through the Tata 1mg website, app and Amazon.

Milky Mist Expands High-Protein Portfolio with Lactose-Free Milk

Milky Mist Dairy Food Limited ("Milky Mist" or "the Company") India's fastest-growing packaged food company, has today expanded its high-protein product portfolio with the launch of Milky Mist High Protein Lactose-free Milk.

In the high-protein milk category the product is available in a convenient 250 ml pack and delivers 25 g of protein, equivalent to more than 30% of the recommended dietary allowance (RDA). It is intended for consumers seeking higher protein intake through their everyday diet and is being introduced in the domestic market through select trade channels, with distribution expected to expand progressively.

The launch builds on the growing demand for high-protein products across Milky Mist's portfolio. Over the past couple of years, the Company has witnessed approximately 50% year-on-year growth in demand across products such as High Protein Paneer, Greek Yogurt and Skyr. The introduction of High Protein Lactose-free Milk further strengthens the Company's presence in this category and expands its offerings to address evolving consumer preferences.

The product is manufactured using ultra-filtration technology, which enables the development of high-protein dairy products through a specialised filtration process. This technology-led approach differentiates the product from formulations that rely on adding protein to an existing product. Milky Mist expects this approach to support product quality and consumer acceptance as demand for high-protein options continues to grow.



With its established processing capabilities and technology-led manufacturing infrastructure, Milky Mist is positioned to scale production in line with market demand. The Company expects High Protein Lactose-free Milk to be an important addition to its portfolio as it continues to expand its presence in the high-protein segment.

Management Commentary

Dr. K Rathnam, Wholetime Director and Chief Executive Officer, Milky Mist Dairy Food Limited, said, "High-protein dairy is a significant growth opportunity for Milky Mist, and we see strong potential to further develop this segment. The launch of High Protein Lactose-free Milk reflects our commitment to driving innovation, expanding our value-added portfolio and responding to evolving consumer needs. Consumers are increasingly looking for products that bring together nutrition and convenience, and our latest launch responds to this shift."

"Backed by our technology-led manufacturing capabilities and growing consumer demand, we aim to scale our high-protein offerings and strengthen our presence in this category. Going forward, we will continue to invest in product innovation and portfolio expansion to build a stronger, more differentiated value-added dairy business."

Greenspace Herbs launches Morimin™,

a whole-leaf Moringa blend for everyday minerals, at Bharat Nutraverse (India), now available in India and the USA

Bengaluru-based herbal extracts and nutraceutical manufacturer Greenspace Herbs has launched Morimin™, a Moringa leaf blend designed to provide minerals and other nutrients from a single botanical source. Unveiled at Nutraverse in India, the product combines Moringa oleifera leaf powder with Moringa leaf extract and is now available to nutraceutical and food brands in India and the United States.

Morimin™ delivers calcium, potassium, magnesium and iron, along with plant protein, dietary fibre and healthy fats. According to the company's laboratory analysis, every 100 g contains approximately 2,218 mg of calcium, 2,905 mg of potassium, 1,483 mg of magnesium, 13.3 mg of iron, 18 g of protein and 18 g of dietary fibre, with no added sugar. The combination of whole-leaf powder and extract is designed to retain the leaf's nutritional components while providing a more consistent concentration of naturally occurring plant compounds, including polyphenols and flavonoids.

Developed and manufactured at Greenspace Herbs' factory and R&D facility in Magadi taluk, Karnataka, Morimin™ undergoes controlled sourcing, drying, extraction, blending and quality testing. The company conducted safety, stability and human studies before the launch. An acute oral toxicity study following OECD Guideline 423 reported no signs of toxicity at the tested doses up to 5,000 mg/kg body weight. A stability study also confirmed the product's physical integrity and macronutrient profile during the study period.

In a 30-day human study involving 10 healthy adults aged 25 to 60, participants consumed 300 mg of Morimin™ daily. Greenspace reported that serum mineral and trace-element levels remained within normal physiological ranges, while participants reported reduced fatigue. The company's findings on nutritional value and acute oral toxicity have been submitted to Current



Nutrition & Food Science and are currently under peer review. According to Founder and Managing Director Shafiulla Hirehal Nuruddin, the launch aims to combine the traditional use of Moringa with scientific testing and consistent manufacturing standards for global markets.



Kurkure Celebrates The Many Tastes of India With a Snack Inspired By South India's Ribbion Pakoda



Across South India, some snacks are more than an occasional craving; they are flavours people have grown up with. Ribbon Pakoda is one such familiar favourite, recognised by its distinctive shape, satisfying crunch and the spices worked into its dough. From a jar in the kitchen to an evening snack shared with family, it carries a familiarity that generations of consumers across the South instantly recognise.

Yet, as lifestyles change, consumers may not always have easy access to the same traditional snacks and familiar tastes they grew up enjoying. Recognising this, Kurkure®, iconic homegrown brand from PepsiCo India, has introduced Kurkure® Ribbon Pakoda, its latest regional innovation inspired by the much-loved South Indian snack and reimagined with Kurkure®'s signature flavour.

The choice of Ribbon Pakoda came from a simple consumer truth- when it comes to snacking, familiarity matters just as much as excitement. Kurkure® Ribbon Pakoda brings these worlds together, made with rice flour along with three dals (urad, chana and moong), with the notes of sesame seeds and black pepper worked into the dough. Turning up the chatpata quotient is a fiery kick of Guntur chilli. Made in rice bran oil, with no palm oil and no artificial colours or flavours, every crunchy ribbon brings together the soul of a well-known South Indian favourite with the unmistakable masti of Kurkure®.

Commenting on the launch, Ankit Agarwal, Marketing Director, Kurkure®, PepsiCo India, said, "Consumers across South India take immense pride in their food traditions, and Ribbon Pakoda is one such snack that evokes familiarity, nostalgia and joy. As a proudly homegrown brand, Kurkure® is constantly looking for ways to celebrate India's diverse food culture. With Kurkure Ribbon Pakoda, we are drawing inspiration from an iconic South Indian favourite and reimagining it through the distinctive Kurkure experience. This launch reflects our commitment to creating products inspired by regional tastes and bringing consumers flavours that feel both exciting and authentically local."

The same insight sits at the heart of the launch campaign. Traditional snacks often carry memories of home and of recipes made by mothers and grandmothers. But in the rush of modern life, recreating those familiar tastes isn't always easy. Kurkure® takes this nostalgia and gives it its characteristic irreverent spin with a simple thought: what if a bite of Ribbon Pakoda tasted so familiar, it felt like grandma herself had made it?

Brought alive in a dramatic South cinema-style cop setting, the film turns the product reveal into an entertaining celebration of that familiar taste and crunch. The campaign will run in Kannada across television and digital, and in Tamil and Telugu across digital, bringing the story to consumers in their own languages.

The launch builds on Kurkure®'s long-term endeavour to create regional snacking experiences inspired by India's varying tastes and cultures. Kurkure Ribbon Pakoda will be available across Karnataka, Andhra Pradesh and Tamil Nadu on neighbourhood kirana stores in a 28g pack priced at INR 10 and a 56g pack priced at INR 20.

PepsiCo India expands its Better for You snacking portfolio with the launch of Quaker® Protein Ladooz and Quaker® Protein Chikki Bites

PepsiCo India is expanding its Better for You snacking portfolio with the launch of Quaker® Protein Ladooz and Quaker® Protein Chikki Bites, taking Quaker® beyond breakfast and into everyday Indian snacking. Bringing together real oats, 12% protein and high fibre in two much loved formats, Rose Dry Fruit Ladooz and Ragi Choco Chikki Bites, the new range makes it easier for consumers to bring protein and fibre into their everyday snacking occasions, at just ₹10. Made with no artificial flavours and no palm oil, the products combine familiar tastes with a more accessible nutritional proposition.

The launch reflects PepsiCo India's focus on translating evolving consumer needs into relevant innovation. To better understand the barriers to protein and fibre intake, PepsiCo India, in collaboration with Euromonitor International and the Indian Institute of Millet Research (IIMR), undertook The State of Protein & Fibre in Urban India, a study exploring how consumers perceive and incorporate these nutrients into their daily diets.

The findings reveal a significant gap between nutritional needs and everyday consumption. While 70% of respondents consume less than 41g of protein daily, below recommended intake levels, 61% fall short of their recommended daily fibre intake. Affordability remains a key challenge, with 60% citing high cost as a barrier to consuming enough protein.

Yet, the appetite for better nutrition is evident. Across generations, 89% of Gen Z, Millennials and Gen X respondents express a desire for protein to be available in more familiar, everyday food formats. Together, these findings highlight a clear opportunity to bridge nutritional gaps by making protein and fibre more accessible, affordable and relevant to existing eating habits.

This is where Quaker® sees an opportunity to make a difference. Rather than asking consumers to change their snacking habits, the brand is bringing protein and fibre into formats they already know and enjoy. By combining the goodness of oats with much loved Indian favourites at an accessible price point, Quaker® Protein Ladooz and Chikki Bites bring PepsiCo India's ambition to democratise nutrition to life, making better for you choices easier to embrace in everyday life.

Commenting on the launch, Saakshi Verma Menon, Chief Marketing Officer – Foods, PepsiCo India, said, "At PepsiCo India, we are evolving our Foods portfolio to meet the changing needs of consumers and offer greater choice across snacking occasions. Better-for-You innovation is a key part of this journey. Our consumer insights, reinforced by our research on protein and fibre intake trends, point to an opportunity to make these ingredients more accessible and easier to incorporate into everyday diets. With Quaker® Protein Ladooz and Chikki Bites, we are bringing together the nutritional benefits of oats with much-loved Indian snacking formats, making nutrition more relevant in snacking rituals. This advances our ambition to democratize protein and fibre by bringing together familiarity, convenience and affordability. As we continue to strengthen our portfolio, our focus remains on creating innovations that respond to evolving consumer needs and make better choices accessible to more Indians."

Sriram Iyer, Marketing Director – Quaker®, PepsiCo India, said, "Quaker® has long been synonymous with the goodness of oats in India, and with this launch it is bringing its trusted nutrition credentials to the snacking category. Ladoo and chikki are formats Indians already enjoy and understand, making them a natural canvas for us to bring together oats, protein and fibre in a familiar and enjoyable way. Our new campaign brings this proposition alive through a daily dilemma – why should choosing nutrition mean compromising on taste? With Protein Ladooz and Chikki Bites, we are excited to expand the role Quaker® can play in consumers' lives and begin a new chapter for the brand in India."



MTR Expands its Sweets Portfolio with New Formats and Innovations



MTR Foods has strengthened its presence in India's sweets category with the launch of eight new products, taking its total portfolio to 27 offerings. The expansion includes traditional favourites, ingredient-led innovations and differentiated formats, reflecting changing consumer preferences for greater variety, new flavours and convenient options for different occasions. The company aims to bring traditional Indian sweets to newer consumption occasions while retaining their familiar tastes and cultural appeal.

The expansion builds on MTR's established Mysore Pak and Gulab Jamun portfolios. Its Mysore Pak range now includes Milk Mysore Pak, Kaju Mysore Pak and a new Ghee Jaggery collection featuring Jaggery Ghee Mysore Pak, Jaggery Ghee Coconut Burfi and Ghee Dry Fruit Burfi. Another addition, MTR Mysore Pak Date Bites, combines Mysore Pak with dates and dry fruits in a two-layered format, positioning the traditional sweet as an everyday snacking option. The Gulab Jamun range has also expanded beyond its existing mixes and ready-to-eat tins to include Dry Jamun, Kala Jamun and Kesar Badam Gulab Jamun.

According to Sunay Bhasin, CEO of MTR, the expansion reflects the company's focus on combining traditional flavours with contemporary formats and evolving consumer preferences. The new products are available across major metropolitan cities through quick-commerce platforms, general trade and modern trade outlets.

Alongside its product expansion, MTR is strengthening its engagement with consumers through its 'India's Sweetest Language' campaign, which uses storytelling, books, live experiences and immersive activations to highlight the cultural significance of sweets in expressing emotions, celebrating occasions and bringing people together.

Chakli, meet Schezwan: Chheda's and Ching's bring together the OG Snack Pack



Some food combinations are planned in research laboratories, others simply happen and become rituals. Chheda Specialities Foods Private Limited brings to you one such combination of two familiar favourites – Chheda's Chakli and Ching's Secret Schezwan Chutney as the 'OG Snack Pack'.

The idea comes from a simple consumer truth: pairing the crunch of traditional chakli with the spicy, garlicky kick of Schezwan chutney. It is a combination that has found its way into homes, offices and snack breaks over the years, particularly in western India. The collaboration now takes that familiar pairing to consumers across the country in one convenient pack. Priced at ₹75, the Chheda's Chakli + Ching's Schezwan Chutney pack will be available across all leading quick-commerce platforms such as Blinkit, Swiggy Instamart, Zepto, and modern trade, general trade outlets across India.

Commenting on the launch, Dharmik Chheda, Director, Strategy & Operations, Chheda Specialities Foods Private Limited, said, "Some of the best food combinations don't come out of a boardroom; consumers create them . Chakli with Schezwan chutney is one of those pairings we have seen people enjoy for years. So, instead of trying to invent something new, we thought, why not give an existing favourite its moment? Chheda's and Ching's are both familiar names in Indian households, and bringing the two together felt like a very natural progression. It's simple, fun and, most importantly, genuinely delicious."

With the launch, the brands are putting the spotlight on something Indian consumers have long been good at – finding their own unexpected food combinations and making them stick.

Sola Makes Bagels Snackable with New Snack Size Launch



Sola, a leading functional food brand, is further shaking up the bread aisle with the launch of two Snack Size Bagel varieties, available at Target stores nationwide. Small in size, big on nutrition, Sola Snack Size Bagels deliver up to 15g of complete protein, 0g added sugar, prebiotic fiber and low net carbs per serving, making it easier to turn everyday snacking moments into something more satisfying. And because great nutrition should never mean settling on flavor, the lineup includes Blu-Berry alongside the highly anticipated return of fan-favorite Chocolatey Chip.

The launch comes at a time when consumers are demanding more from their snacks – especially parents. According to NielsenIQ data, 35% of parents purchasing snacks for their Gen Alpha children prioritize natural ingredients, while 34% specifically seek high-protein options. With children averaging roughly three snacks a day, parents have more opportunities, and more reasons, to choose snacks that deliver meaningful nutritional value alongside great taste.

Sola Snack Size Bagels are made for this new era of snacking: convenient, craveable and packed with functional nutrition. Each serving delivers more than 1g of protein for every 10 calories, offering a strong protein-to-calorie ratio, and complete protein, delivering all 9 essential amino acids. And only two Snack Size Bagels provide 28% of the Daily Value for protein.

"Consumers don't want to choose between food that tastes great and food that works harder for them," said Kevin Brouillette, President, Spring Foods. "Snack Size Bagels were created to give people a more exciting way to snack – with the protein, fiber and nutrition they're looking for, in a portion that fits naturally into their day."

The new Snack Size Bagel lineup is Non-GMO Project Verified and made with Avocado Oil, giving consumers even more reasons to feel good about reaching for Sola throughout the day.

- Blu-Berry Snack Size Bagels – Sola's #1 best selling flavor now in mini form, delivering 15g complete protein, 3g net carbs and 0g added sugar
- Chocolatey Chip Snack Size Bagels — A longtime fan-favorite flavor with 14g complete protein, 120 calories and 0g added sugar

The launch follows Sola's Target expansion earlier this year, growing the brand's Target portfolio and giving shoppers even more ways to incorporate Sola into their everyday routines. Find Sola Snack Size Bagels in the bread aisle at a suggested retail price of $7.99.

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India Gets Iced: Smirnoff ICE Brings Exciting new Flavours to Social Occasions



Smirnoff ICE arrives in India with exciting new flavours and a vibrant identity, introducing an easy, refreshing ready-to-drink format designed for today's consumers. Rolling out across Goa, Bengaluru and Mumbai, Smirnoff's globally recognised offering is suitable for every social occasion, from casual outings and house parties to spontaneous plans with friends.

In line with Diageo's purpose of "Crafting iconic drinks chosen for life's moments," the launch expands Smirnoff's RTD portfolio in India with a distinctive taste giving consumers greater choice beyond traditional options such as beer. The ready-to-drink category is among the country's fastest-growing segments, increasing 12% in volume versus last year. Smirnoff ICE taps into this momentum with a playful, flavour-led proposition backed by Smirnoff's global equity and a bold new identity.

Commenting on the announcement, Ruchira Jaitly, Chief Marketing Officer, Diageo India, said: "India is evolving as a new generation seeks out fresh formats, new flavours, more spontaneous ways to socialise and explore new drinking occasions. Smirnoff ICE enters this space with easy, playful and flavour-forward propositions in tune with how Gen Z connects and celebrates today. Leveraging Smirnoff's global legacy in a vibrant new taste and format experience, we aim to make discovery more exciting, spark new social occasions and shape the brand's next chapter of growth in India."

The launch reflects Diageo India's ambition to anticipate evolving preferences and shape the future of drinking through consumer-led innovation. Available in two expressions — Smirnoff ICE at 4% ABV and Smirnoff ICE MAX at 8% ABV — the portfolio caters to different preferences and moments. As the brand expands beyond its first-phase markets, it will continue to build relevance through engaging experiences and spontaneous social moments, taking the spirit of Smirnoff ICE to more people across the country.

Essential Baking Launches New Sandwich Sourdough Line



Essential Baking, one of the fastest-growing sourdough brands, is bringing 30 years of artisan sourdough expertise to the sandwich aisle with the launch of four new Organic Sandwich Sourdough Loaves, now available at Target stores nationwide.

Made for the way people eat today, the new lineup combines authentic sourdough with the convenience of an everyday sandwich bread. Consumers can choose from Oats & Honey, Multigrain, Artisan White, and Cinnamon – making it easier to bring a little more flavor, quality and craftsmanship to everything from morning toast to lunchtime sandwiches and after-school snacks.

Every loaf is Organic, Non-GMO, crafted with avocado oil and an authentic sourdough starter. Three varieties proudly carry The Whole Grains Council stamp, delivering 9 to 15 grams of whole grains per slice, including nutrient-dense superfoods like millet, flax, and oats. Essential Baking delivers bread that goes well beyond the ordinary, delivering up to 30g whole grains per sandwich.

"Our goal with Essential Baking is to give consumers a premium and healthful sandwich experience that fits naturally into everyday meals and creates more opportunities to make time at home feel special." said Kevin Brouillette, President, Spring Foods.

Research shows that 54% of adults consider the kitchen the "heart of the home," spending an average of an hour each day cooking and preparing food. Essential Baking's new sandwich breads are designed to make those everyday moments more enjoyable – bringing the taste and craftsmanship of authentic sourdough into a format that's ready when life gets busy.

The new Essential Baking lineup brings a different take on the classic sandwich loaf, with something for every kind of bread lover:

- Oats & Honey – A wholesome blend of eight grains and seeds, finished with a touch of natural honey sweetness. With 15g of whole grains per slice, it's a deliciously hearty choice for breakfast, sandwiches and beyond.
- Multigrain – Six grains and seeds come together in this hearty, grain-forward sourdough, delivering satisfying texture and flavor with 11g of whole grains per slice.
- Artisan White – A fresh take on a classic. This soft, versatile white sandwich bread gets an elevated flavor from an authentic sourdough starter and 0g sugar per serving.
- Cinnamon – Lightly spiced, this sliced sourdough delivers 9g of whole grains per serving and brings a little something extra to breakfast and snack time. Available exclusively at Target for a limited time.
- The new Essential Baking Organic Sourdough Sandwich Breads are available now at Target stores nationwide for a suggested retail price of $6.89.

Adie Broswon Group Expands MOOOZ Litchi Vodka's Footprint with Launch in Punjab and Chandigarh



Strengthening its presence across North India, The Adie Broswon Group has announced the launch of MOOOZ Sparkle Jamun Vodka in Punjab, Chandigarh and Uttarakhand. The expansion marks another significant step in the company's strategy to widen the reach of its contemporary flavoured vodka portfolio and strengthen its presence across key markets in the region. Following its introduction across Delhi, Haryana and Uttar Pradesh, MOOOZ Jamun is now expanding into three additional markets, building on the brand's growing regional footprint. The launch reflects Adie Broswon's continued focus on developing differentiated homegrown spirits that combine familiar Indian flavours with contemporary craftsmanship and evolving consumer preferences.

Inspired by one of India's most distinctive native fruits, MOOOZ Sparkle Jamun Vodka brings the characteristic sweet-tart profile of jamun to the flavoured spirits category. With consumers increasingly exploring distinctive flavours and locally inspired drinking experiences, the brand offers a contemporary interpretation of a familiar Indian taste, combining nostalgic appeal with versatility across different serves and cocktails.

Developed under Adie Broswon's MOOOZ portfolio, MOOOZ Sparkle Jamun Vodka is crafted from carefully selected rice sourced from Punjab using Extra Neutral Alcohol and demineralised water. Staying true to the brand's grain-to-glass philosophy, every batch undergoes triple distillation followed by a proprietary Platinum, Gold and Diamond filtration process, resulting in a clean, smooth and versatile vodka.

Designed for contemporary social occasions, MOOOZ Jamun can be enjoyed over ice, paired with soda or tonic, or used as a base for fruit-forward cocktails, making it suitable for casual gatherings, celebrations and home entertaining. The expansion across Punjab, Chandigarh and Uttarakhand further reinforces Adie Broswon's strategy of building a portfolio of quality homegrown spirits rooted in Indian flavour inspiration. With its widening presence across North India, the company continues to focus on strengthening distribution and making its differentiated offerings accessible to consumers across important regional markets.

MOOOZ Sparkle Jamun Vodka is now available at leading retail outlets across Punjab, Chandigarh and Uttarakhand. The 750 ml bottle is priced at ₹880 in Punjab, ₹700 in Chandigarh and ₹920 in Uttarakhand.



Taali Pokémon Cheese Balls Turns Snacking Into a Collectible Experience



Taali has partnered with Pokémon to launch Taali Pokémon Cheese Balls, combining the brand's approach to better-for-you snacking with the global entertainment franchise's cross-generational appeal. The new product brings Pokémon into a popular Indian snacking format and is positioned as a non-fried, palm-oil-free snack made without artificial colours or preservatives. The launch follows an earlier announcement by the two brands, with the product now unveiled as part of their collaboration.

Each pack contains one of 12 collectible Pokémon stickers, allowing consumers to build a complete collection. By scanning the QR code on the packaging, consumers can digitally track their collections, unlock rewards and participate in opportunities to win exclusive Taali Pokémon merchandise, including tote bags, diaries, keychains and gym bags. The initiative aims to extend consumer engagement beyond the product through interactive and collectible experiences.

According to Aarti Kaji, Co-founder of Taali, the collaboration aims to combine improved snack choices with an engaging consumer experience. The launch also reflects Taali's strategy of introducing new variations of familiar Indian snacks while expanding its product portfolio. Taali Pokémon Cheese Balls will initially be available nationally and exclusively on Blinkit for 60 days, followed by expansion across other leading e-commerce and quick-commerce platforms and wider offline distribution.

AI-Powered Food Processing:

From Intelligent Automation to Predictive Manufacturing



Kanika Banga

The Shift Towards Intelligent Food Manufacturing

The food processing industry is entering a new phase of digital transformation, where production efficiency increasingly depends on the ability to collect, analyse and act on operational data. While conventional automation has improved production speed, consistency and labour efficiency, artificial intelligence (AI) is taking these capabilities further by enabling machines and production systems to interpret information, recognise patterns and support operational decisions.

Traditionally, food processing facilities have relied on predefined operating parameters, scheduled maintenance programmes and periodic quality inspections. Although these methods remain important, they can be less effective when dealing with variations in raw material characteristics, environmental conditions, equipment performance and product quality. AI-powered systems address these limitations by analysing large volumes of historical and real-time production data to identify patterns and detect deviations before they affect manufacturing operations.

Machine learning algorithms can predict process variations and recommend adjustments, while computer vision systems inspect products for defects, colour inconsistencies, size variations and packaging irregularities. Smart sensors continuously monitor critical parameters such as temperature, pressure, moisture, humidity, flow rate and vibration. When integrated into a connected manufacturing environment, these technologies create a responsive production ecosystem. Instead of simply executing programmed instructions, processing equipment can increasingly respond to changing conditions, helping manufacturers move towards predictive and adaptive manufacturing.

Real-Time Process Monitoring and Intelligent Process Control

One of the most significant applications of AI in food processing is real-time monitoring and control of production parameters across stages such as raw material handling, sorting, mixing, grinding, thermal processing, cooling, filling and packaging. By integrating data from sensors, programmable logic controllers (PLCs), supervisory control and data acquisition (SCADA) systems and manufacturing execution systems (MES), AI-enabled platforms continuously analyse operating conditions and identify relationships between variables that influence product quality and production efficiency. Unlike conventional monitoring systems that rely on operators to respond to deviations, machine learning models can detect unusual patterns and predict potential process variations before they affect production.

These capabilities are being applied across different food processing operations. In dairy processing, AI analyses temperature, pressure, flow rate and holding time during pasteurisation to maintain consistent processing conditions. In beverage manufacturing, it monitors mixing ratios, product temperature, carbonation levels and filling performance, while bakery operations use AI to track dough temperature, moisture, mixing time and fermentation conditions. In snack manufacturing, intelligent systems evaluate frying temperature, oil quality, product moisture and processing duration. By identifying deviations at an early stage, AI can alert operators, recommend corrective measures or automatically adjust process parameters within validated operating limits, helping reduce product losses and maintain consistent quality.

Computer Vision and AI-Driven Quality Inspection

AI is creating significant opportunities in food quality control by enabling faster, more consistent and automated product inspection. While conventional methods rely on manual sorting, visual examination and laboratory testing, AI-powered computer vision uses industrial cameras, image-processing software and deep learning algorithms to inspect products moving along conveyor belts. Deep learning models, particularly convolutional neural networks (CNNs), are trained on large image datasets to identify defects and classify products based on their visual characteristics, including bruises, cracks, discolouration, foreign materials, irregular shapes, incorrect sizes and surface imperfections.

In fruit processing, computer vision evaluates colour, size, shape and external condition to grade products according to quality specifications. In potato processing, AI identifies surface defects, green patches and irregular shapes before cutting and frying, while bakery manufacturers use camera-based inspection to monitor product dimensions, colour development and surface consistency. Advanced technologies such as hyperspectral imaging combine visual information with spectral data across multiple wavelengths. When supported by appropriately trained and validated AI models, these systems can help detect internal defects, moisture variations and compositional differences that conventional cameras may not identify. AI-based inspection can also integrate with automated sorting equipment, robotic pick-and-place systems and rejection mechanisms to remove products that fail to meet specifications.

Packaging inspection is another important application, where computer vision examines labels, barcodes, batch codes, fill levels, cap placement and overall packaging appearance. Optical character recognition (OCR) helps verify printed information, including manufacturing and expiry dates. These systems also generate inspection records that enable manufacturers to identify recurring defects and trace them to specific batches or processing conditions. However, factors such as lighting variations, reflective surfaces, product orientation and moisture can influence detection accuracy, making appropriate camera positioning, controlled lighting and regular AI model validation essential for reliable inspection.

Predictive Maintenance: Moving Beyond Scheduled Equipment Servicing

Equipment reliability directly influences production capacity, operating costs and

delivery schedules. Machinery such as pumps, compressors, motors, conveyors, mixers, homogenisers, heat exchangers, refrigeration systems and filling machines must operate consistently to maintain production efficiency. Traditional maintenance strategies include reactive maintenance, where equipment is repaired after failure, and preventive maintenance, where servicing takes place at predetermined intervals. AI strengthens the shift towards predictive maintenance by analysing equipment performance data to identify early indicators of mechanical problems. Smart sensors installed on motors, bearings, pumps and other critical equipment collect information such as vibration, temperature, pressure, current consumption, acoustic signals and operating speed. Machine learning algorithms analyse these measurements alongside historical maintenance records to recognise patterns associated with abnormal operation.

For example, unusual vibration patterns may indicate bearing deterioration, shaft misalignment or imbalance. Increasing operating temperatures may suggest excessive friction or cooling problems, while changes in pump pressure and power consumption can indicate declining performance.

Instead of waiting for equipment failure, AI models can identify warning signs and estimate the likelihood of potential malfunctions. Maintenance teams can then schedule inspections and component replacements before problems interrupt production. This is particularly valuable in continuous processing environments, where an unexpected shutdown can affect several interconnected operations. Predictive maintenance can also improve spare-parts management by helping manufacturers anticipate component replacement requirements and reduce unnecessary maintenance interventions. However, reliable implementation requires accurate sensor data, sufficient historical information and models capable of distinguishing normal operating variations from genuine equipment deterioration.

Smart Sensors and the Industrial Internet of Things

Smart sensors and the Industrial Internet of Things (IIoT) provide the technological foundation for AI-powered manufacturing by collecting and communicating production information across processing facilities. Connected sensor networks can transmit data continuously to central monitoring platforms, edge computing devices and cloud-based analytical systems. In food processing, sensors monitor parameters such as temperature, humidity, pH, pressure, conductivity, viscosity, dissolved oxygen, moisture content, flow rate and vibration. In fermentation processes, monitoring temperature and pH is important for maintaining suitable operating conditions. In dairy processing, temperature, pressure and flow measurements support thermal treatment and product transfer. In drying operations, humidity, air temperature and product moisture measurements help maintain the desired moisture level while managing energy consumption. When sensor readings are connected to AI platforms, algorithms can identify relationships between process conditions and product characteristics, detect unusual operating patterns and generate alerts when production begins moving away from established parameters.

Edge computing further strengthens these capabilities by processing selected data close to the equipment rather than transferring every measurement to a remote cloud platform. This reduces communication delays and supports faster responses in applications requiring immediate action. However, connectivity alone does not create an intelligent factory. Meaningful results depend on integrating, standardising and analysing information from different machines and production systems.

Data-Driven Production Planning and Manufacturing Optimisation

AI is increasingly being used to optimise production planning and overall manufacturing performance by analysing historical sales, demand forecasts, inventory levels, raw material availability, equipment capacity and production data. Machine learning models can predict demand by identifying seasonal variations, historical sales patterns and market trends, helping manufacturers plan production volumes, optimise raw material procurement and minimise overproduction. AI-powered scheduling systems can also determine efficient production sequences for facilities handling multiple products and formulations. By considering equipment cleaning, ingredient replacement, line adjustments and sanitation requirements, these systems can reduce unnecessary changeover time while maintaining hygiene and food safety standards.

Another important application is yield optimisation and resource management. AI algorithms analyse raw material characteristics, processing conditions and output data to identify opportunities to minimise losses during cleaning, cutting, mixing, extraction, cooking and packaging. Intelligent systems can also monitor energy and water consumption alongside equipment performance, production schedules and temperature requirements to improve resource efficiency and reduce processing time without compromising product safety or quality. These capabilities are particularly valuable in energy-intensive operations such as drying, evaporation, refrigeration, pasteurisation and sterilisation, where data-driven adjustments can improve operational efficiency and support more sustainable manufacturing.

Digital Twins and Predictive Manufacturing

Digital twins represent another important development in intelligent manufacturing. A digital twin is a virtual representation of a physical machine, production line or manufacturing process that uses operational data, engineering information and analytical models to reflect the behaviour of the corresponding physical system. In food processing, digital twins can represent equipment such as heat exchangers, dryers, mixers, refrigeration systems and complete production lines. By combining real-time sensor readings with simulation models and AI algorithms, manufacturers can examine how different operating conditions may influence production performance.

For example, a digital twin of a thermal processing system can evaluate the relationship between product temperature, flow rate, processing time and energy consumption. Similarly, a digital representation of a drying system can assess the effects of air temperature, humidity, airflow and product characteristics on moisture removal.

Engineers can use these simulations to examine different operating scenarios before implementing changes on the actual production line. Digital twins can also compare actual equipment performance with expected operating behaviour to identify potential faults or inefficiencies. The technology offers opportunities to reduce trial-and-error adjustments and improve process optimisation. However, its effectiveness depends on accurate engineering models, reliable sensor data and continuous validation against actual operating conditions.

Food Safety, Traceability and Risk Prediction

AI is also creating opportunities to strengthen food safety monitoring and traceability. By combining machine learning, connected sensors, computer vision and digital records, manufacturers can identify potential risks earlier in production. AI systems can analyse production records, environmental monitoring data, temperature histories, cleaning records and sensor readings to identify patterns associated with possible food safety concerns. Temperature monitoring systems, for instance, can detect deviations during chilled processing and storage, while predictive models can help assess conditions that may favour microbial growth or accelerate product deterioration. When integrated with metal detectors, X-ray inspection systems and other established

technologies, AI can help analyse inspection data, identify recurring rejection patterns and investigate potential contamination sources.
AI-assisted traceability platforms can connect information relating to raw material suppliers, production batches, processing conditions, packaging records and distribution. This improves the ability to investigate quality concerns and identify affected batches.

Another emerging application is predictive shelf-life assessment. Machine learning models can analyse product composition, processing history, storage temperature and packaging characteristics to estimate quality deterioration under different conditions. Such insights can support inventory management, distribution planning and cold-chain monitoring. Nevertheless, AI predictions must complement established microbiological testing, validated food safety procedures and regulatory requirements rather than replace them.

Challenges in Implementing AI Across Food Processing Facilities

Despite its potential, AI adoption involves several technical, operational and financial challenges.

- **Data quality and availability:** AI models require reliable and representative datasets. Information distributed across different machines and software platforms, inconsistent data formats and missing readings can affect model performance.
- **Integration with existing infrastructure:** Many facilities operate legacy equipment that was not designed for digital connectivity. Integrating AI platforms with PLCs, SCADA, MES and enterprise resource planning (ERP) systems may require additional sensors, communication infrastructure and upgrades.
- **Investment and implementation costs**: Adoption involves more than purchasing software. Manufacturers may need to invest in industrial cameras, sensors, computing devices, connectivity, data storage, cybersecurity and specialist technical support. Smaller manufacturers may find these initial investments difficult to justify.
- **Workforce skills and training**: Successful implementation requires collaboration between food technologists, process engineers, maintenance teams, data scientists and automation specialists. Employees must understand how to interpret AI-generated insights and incorporate them into operational procedures.
- **Reliability and model validation:** AI models must be tested under actual plant conditions and monitored regularly to ensure that their predictions remain accurate across different products and operating environments.
- **Cybersecurity**: Greater connectivity increases exposure to cyber threats. Manufacturers must establish appropriate access controls, network security, data protection and system recovery procedures.

Another important consideration is excessive dependence on automated recommendations. AI systems can generate incorrect predictions when input data is unreliable or operating conditions change. Human oversight therefore remains essential, particularly for food safety, product release and equipment protection.

Building an AI-Ready Food Manufacturing Facility

The transition towards intelligent manufacturing does not necessarily require complete replacement of existing production infrastructure. A phased implementation strategy can help businesses introduce AI while managing investment and operational risks. The first step is identifying production areas where data-driven improvements can deliver measurable value. These may include equipment with frequent breakdowns, processes with high rejection rates, energy-intensive operations or production lines requiring extensive manual inspection. Manufacturers can then introduce connected sensors and data acquisition systems to establish reliable visibility into equipment performance and process conditions. The next stage involves deploying targeted AI applications, such as predictive maintenance for critical motors and pumps, automated visual inspection or intelligent monitoring of temperature and moisture during processing.

Once these applications demonstrate operational benefits, manufacturers can expand AI integration across multiple production lines and connect operational data with production planning, quality management and inventory systems. Implementation should be supported by measurable indicators such as overall equipment effectiveness (OEE), unplanned downtime, rejection rates, production yield, energy consumption, water usage and maintenance costs. Comparing these indicators before and after implementation helps evaluate the actual business value of AI investments.

The Road Ahead: Towards Adaptive Food Processing

The next phase of AI adoption is likely to move beyond individual applications towards integrated systems capable of coordinating multiple production activities. Advances in machine learning, generative AI, robotics, digital twins and industrial connectivity are creating opportunities for more adaptive manufacturing environments. AI-enabled robotics and computer vision can support material handling, product sorting, packaging, palletising and repetitive inspection activities. Explainable AI (XAI) is another emerging development, aiming to make algorithmic recommendations more understandable to operators and engineers. This is particularly important in food manufacturing, where decisions must be transparent and verifiable.

Generative AI may also support manufacturing teams by analysing production reports, summarising equipment performance, retrieving technical documentation and assisting with troubleshooting. However, its use in critical process control requires appropriate safeguards and verified information. The growing integration of AI with Industry 4.0 technologies is laying the foundation for more connected, responsive and resource-efficient food factories. Nevertheless, the transition towards fully autonomous manufacturing will be gradual, with reliability, validation, cybersecurity and human supervision remaining essential.

Conclusion

AI-powered food processing represents a significant evolution in the way manufacturers manage production, quality and operational performance. By combining artificial intelligence, machine learning, computer vision, smart sensors and predictive analytics, food manufacturers can move beyond conventional automation towards intelligent and data-driven production environments. From real-time process monitoring and automated quality inspection to predictive maintenance, production planning and resource optimisation, these technologies offer opportunities to improve consistency, reduce downtime, minimise waste and strengthen manufacturing efficiency.

However, successful adoption depends less on the sophistication of individual algorithms and more on their effective integration with processing equipment, quality management systems and established manufacturing practices. Reliable data, validated models, workforce capabilities and appropriate human oversight will remain fundamental. Ultimately, the future of food processing will not be defined simply by how much automation a factory installs, but by how effectively it uses data to anticipate problems, adapt to changing production conditions and make informed decisions. The transition from intelligent automation to predictive manufacturing is setting the direction for the next generation of food processing facilities.

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Turning Inspection Data into Business Value





Ian Scott-Mance, Head of Digital Customer Experience, Mettler Toledo

Turning inspection data into real business value is no longer a technical challenge - it is a competitive necessity. Many manufacturers already collect vast amounts of inspection and production data, but when that information remains fragmented across machines, spreadsheets, and manual records, its true potential is lost. This article explores how centralised data management transforms disconnected data into a single, reliable source of insight that reduces manual effort, improves visibility, and enables faster, more confident decision-making.

By examining practical outcomes - from reduced reporting time and less waste to stronger compliance and multi-site performance benchmarking - this article demonstrates how solutions like ProdX™ from Mettler Toledo help manufacturers move beyond data collection to data-driven action. It highlights how organisations can uncover hidden inefficiencies, respond to issues earlier, and create measurable, scalable value across production lines and sites. For manufacturers looking to improve efficiency, strengthen audit readiness, and align teams around a single version of the truth, this is a clear roadmap for turning inspection data into a sustained operational advantage.

Production lines generate large volumes of information every day, from production volumes and inspection results to rejects, downtime, and performance tests. Yet when that data is spread across individual machines, paper records and disconnected spreadsheets, turning it into useful insight can be slow and resource intensive. Data management software such as ProdX™ brings inspection data together in one central platform. This gives production, quality, IT, and management teams a consistent view of what is happening across the line, helping them spend less time gathering information and more time improving performance.

Reducing manual work

One of the clearest benefits to data management software is time. Without a central system, teams may need to copy information from logbooks, export data from individual devices or build reports manually in Excel. These repetitive tasks can take several hours per line each week. By automatically collecting and organising inspection data, software reduces this administrative burden. Scheduled reports, alerts and standard templates can also remove recurring tasks that might otherwise depend on one experienced employee in each plant.

The result is not simply faster reporting. Quality and production teams also have more time to investigate problems, improve processes and support the production line.

Improving visibility and controlling costs

Centralised data also makes it easier to understand where money is being lost. Trends in rejects, rework, waste, and downtime can be identified earlier, before a small issue becomes an expensive recurring problem. For example, if false rejects rise on a particular line or during a specific production run, teams can use the data to investigate the cause and adjust the process. Reducing unnecessary rejects can lower scrap and rework costs while recovering valuable production time.

Centralised data can also reduce the time and pressure involved in reporting and meeting compliance requirements. At Pro Pet Austria, for example, ProdXTM automatically records production parameters, batch information, reject data and inspection-system performance tests. This has reduced the workload associated with manual records and spreadsheets, while giving quality and production teams more complete information for audits and performance analysis.

Supporting traceability and compliance

Data management software can also strengthen control over production records by providing authorised access, consistent documentation and a complete audit trail. This reduces reliance on paper records, portable storage devices and individual spreadsheets that may be incomplete, duplicated or difficult to retrieve.

When an auditor, retailer or customer requests information, teams can access relevant records much more quickly. The same applies when investigating a complaint. Batch and inspection data can be retrieved in minutes rather than requiring an extensive search across multiple systems.

Creating one version of the truth

When departments maintain separate reports, discussions can become focused on whose figures are correct rather than what action is needed. A central platform gives production, quality, and management teams access to the same information, including measures such as overall equipment effectiveness, reject rates and performance trends. This supports faster, fact-based decisions and helps different functions work towards the same priorities.

For multi-site manufacturers, standard reporting also allows leadership teams to compare plants on a like-for-like basis. Strong performance can be identified and replicated elsewhere, while areas requiring investment become easier to see.

Delivering value at scale

Implementation is typically a one-off project involving system connections, report configuration, training and process development. The value, however, continues every day. Each additional inspection device or connected line removes another separate source of manual data. Reports and templates can then be reused across further lines and sites without multiplying the administrative workload.

Inspection-focused platforms are not intended to replace enterprise resource planning, manufacturing execution or supervisory control systems. Instead, they complement them by providing deeper device-level and quality-event information that production and quality teams can use day to day.

Turning data into lasting value

The return on investment for any given manufacturing site will depend on the size of the operation, the amount of manual work being replaced and how consistently the data is used. For many manufacturers, the value comes from several improvements working together, for example, less time spent preparing reports, lower waste and rework, faster investigations and fewer compliance surprises.

To make that value visible, manufacturers should agree a small set of measures before implementation. These might include false reject rates, waste, rework, reporting time and the time needed to close an investigation. Comparing performance before and after implementation creates a clearer picture of where savings are being made.

Clear ownership, practical training, and agreed processes are also important if the software is to become part of everyday production and quality routines. Once embedded, the benefits can continue to grow as more lines, users and sites are connected.

Ultimately, the real value of data management software lies not simply in collecting more information, but in making that information easier to trust, share and act on. By replacing fragmented records with a clearer view of performance, manufacturers can respond to problems sooner, make better-informed decisions, and turn inspection data into an ongoing business advantage.

Discover how a connected data management strategy can help improve compliance, reduce operational risk, and unlock greater efficiency across your production environment by visiting: www.mt.com/prodx-pr.

New Gea Procoater offers Food

Processors Advanced Wet Coating Quality and Efficiency



GEA is introducing the GEA ProCoater, a new wet coating machine developed to help food processors achieve more stable batter flow, more consistent coating pickup and higher line efficiency in the production of coated food products.



Precise and repeatable control of batter

Coated convenience foods remain a dynamic growth segment, driven by demand for crisp textures, visual appeal and new product formats such as plant-based and hybrid foods. At the same time, manufacturers must manage rising cost pressure, complex coating recipes, tighter quality requirements and limited access to skilled operators. The GEA ProCoater addresses these challenges at a critical process step by enabling precise, repeatable control of batter application for poultry, pork, fish, cheese, plant-based and hybrid products.

A key focus of the new system is batter stability. The ProCoater's patent-pending guided return flow system reduces air entrainment and foam formation by up to 80 percent, creating a calmer batter flow and a more uniform curtain. This helps processors reduce defects such as voids and white spots, while maintaining coating performance over long production runs and across a wide range of batter viscosities.

Design features supporting process control

The machine combines this stable flow with practical process-control features for everyday production. Adjustable scrapers enable fine corrections during operation without stopping the line, while smart air knives deliver even blow-off across the full belt width to support accurate coating weight and uniform appearance. An optimized infeed transfer supports smooth product entry, and a patent-pending batter retention plate and an optional bottom batter layer supply device ensure full coating coverage on the product bottom side and keep products firmly positioned during coating to prevent floating or drifting. For processors, the result is a controlled wet coating process from start-up to shut down. Consistent batter pickup helps reduce rework, B-grades and product giveaway, while efficient batter use improves yield and line cleanliness. The ProCoater is available for belt widths of 400, 600 and 1000 millimeters, allowing manufacturers to align the technology with different line layouts, capacities and product portfolios.

"With the GEA ProCoater, we focused on giving processors reliable control over one of the most quality-critical stages in coated food production," says Ben Kop, Application Specialist at GEA. "By stabilizing batter flow and simplifying adjustment, the machine helps operators achieve consistent results with less intervention and greater confidence." GEA complements the new machine with application expertise, food technology support and access to Technology Centers for product testing, process validation and new product development under real production conditions. Together with GEA's global service organization, this support helps customers optimize recipes and coating parameters, maintain equipment performance and reduce risk when scaling new coated food products.

Intelligent Inspection and Sorting: Minimising Contamination and Maximising Quality

Anand Prakash



Sorting is a critical operation in food and beverage manufacturing, directly influencing product safety, quality, consistency and processing efficiency. As manufacturers face increasing production demands, stricter food safety regulations and rising consumer expectations, conventional manual inspection and mechanical grading methods are increasingly being complemented by advanced automated sorting systems. These technologies combine high-resolution cameras, optical sensors, lasers, X-ray imaging, spectroscopy and intelligent software to examine food products according to characteristics such as colour, size, shape, weight and material composition. By identifying defective products, unwanted materials and quality variations, automated sorting helps manufacturers improve product standards, minimise raw material losses and maintain consistent production.

Optical sorting is among the most widely used technologies in food processing. It employs high-resolution cameras, specialised lighting and image-processing software to examine products moving along conveyors or chutes. The system identifies differences in colour, shape, size and surface characteristics before activating rejection mechanisms, such as air jets or mechanical gates, to remove unwanted items. Advanced optical sorters can distinguish between acceptable products, discoloured ingredients, damaged produce and certain foreign materials. They are widely used in fruit and vegetable processing, grains, pulses, nuts, seeds, coffee and snack manufacturing.

Key Sorting Technologies

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Laser sorting uses laser illumination and optical sensors to identify differences in the surface properties and material characteristics of products. Depending on the sensor configuration, these systems can distinguish materials through their optical response, fluorescence and other measurable properties. This makes them useful for identifying certain foreign materials and defective ingredients that may be difficult to distinguish through conventional colour-based sorting. Applications include nuts, seeds, grains, dried fruits and vegetables.

X-ray inspection technology uses differences in material density and X-ray absorption to detect foreign bodies and internal abnormalities. Unlike optical systems, which primarily examine visible surface characteristics, X-ray equipment can inspect the internal structure of products and packaged foods. It is particularly effective in detecting dense contaminants such as metal, glass, stones and calcified bones. The technology is widely used in meat, poultry, seafood, dairy, bakery, confectionery and ready-to-eat food processing.

Mechanical sorting relies on physical characteristics such as size, weight, shape and density. Equipment such as vibrating screens, sieves, rollers, grading drums and conveyors separates products into different categories. Although relatively traditional, mechanical sorting remains important for handling large volumes of bulk materials and is frequently used as a preliminary sorting stage for grains, pulses, seeds, nuts, fruits and vegetables.

Near-infrared (NIR) sorting uses spectroscopy to analyse how materials absorb and reflect near-infrared light. Different materials have distinct spectral characteristics, allowing sensors to identify variations in chemical composition that may not be visible to conventional cameras. Depending on the application and calibration, NIR systems can help assess moisture, protein, fat and other compositional parameters while distinguishing certain unwanted materials. They are particularly useful in processing grains, nuts, seeds, pulses, potatoes and dried fruits.

Importance of Sorting in Food Manufacturing

Advanced sorting systems play an important role in strengthening food safety by identifying and removing physical contaminants that may enter production through agricultural raw materials, transportation, storage or processing equipment. Optical systems detect visually distinguishable foreign materials, while laser-based sensors and X-ray inspection identify additional materials based on their optical properties and density. Combining different technologies at appropriate processing stages provides more comprehensive inspection and reduces the risk of contaminated products reaching consumers.

Sorting also contributes to consistent product quality by separating items that do not meet predefined specifications. Differences in size, colour, shape, ripeness and physical condition can affect product appearance, processing performance and consumer acceptance. Optical systems remove discoloured or

damaged produce, while mechanical graders ensure uniformity in size. NIR and other sensor-based technologies can provide additional information about selected quality and compositional characteristics.

Another major benefit is improved raw material utilisation. Inaccurate sorting can result in the unnecessary rejection of usable ingredients, increasing production costs and food waste. Advanced systems improve separation accuracy, helping manufacturers recover acceptable raw materials and reduce reprocessing and disposal. Automated sorting also increases productivity by inspecting large volumes continuously, reducing dependence on manual inspection and supporting uninterrupted production. When integrated with conveyors, feeders and packaging equipment, these systems improve process flow and operational efficiency.

Addressing Food Safety Challenges

Food manufacturers must manage several risks, including physical, microbial and chemical contamination, allergen cross-contact and product deterioration. Sorting and inspection technologies help address specific risks, but their capabilities vary. Optical and X-ray systems are particularly valuable for physical contamination control, while spectroscopy-based technologies can identify selected material and compositional differences. However, conventional sorting equipment cannot reliably detect pathogens such as Salmonella, E. coli and Listeria. Microbial safety must therefore be managed through hygienic processing, validated thermal treatments, sanitation, environmental monitoring and microbiological testing.

Chemical contamination from pesticide residues, cleaning agents, lubricants and other substances also requires appropriate controls. NIR and hyperspectral imaging can identify certain chemical or compositional variations when detection models are properly developed and validated, but they cannot replace laboratory residue analysis and supplier verification.

Allergen management is another important consideration. Cross-contact can occur when allergenic ingredients share equipment, conveyors or storage facilities with other products. Dedicated production lines, segregated handling, validated cleaning procedures and controlled production scheduling remain essential. Sorting systems can support ingredient separation, but conventional optical, laser and X-ray technologies cannot reliably identify trace allergenic proteins.

Physical defects such as bruises, cuts, discolouration and decay can also compromise product quality and increase susceptibility to deterioration. Optical and multispectral imaging systems help identify surface defects, while mechanical sorting separates products according to size and shape. For finished products, automated vision inspection, optical character recognition, barcode verification and code-reading systems can check product identity, batch codes, expiry dates and labelling information, including allergen declarations.

Emerging Trends in Sorting Technology

Artificial intelligence (AI) and machine learning are transforming automated sorting by enabling systems to recognise complex product variations and defects. Deep-learning algorithms analyse large datasets of product images and sensor readings to distinguish acceptable products from defective items and certain foreign materials. Unlike conventional systems that rely primarily on predefined thresholds, AI-enabled sorters can identify more subtle differences and improve classification through validated model development.

Hyperspectral imaging is another emerging technology that combines imaging with spectroscopy to capture information across multiple wavelengths. It provides detailed spectral data that can reveal differences in material composition and selected product characteristics. When combined with optical cameras, NIR sensors and other inspection technologies through sensor fusion, it can improve product classification and inspection accuracy.

The integration of Internet of Things (IoT) sensors and industrial connectivity is making sorting equipment part of connected manufacturing environments. Real-time monitoring of throughput, rejection rates, operating conditions and equipment performance helps manufacturers optimise processes. Predictive maintenance systems analyse equipment parameters to identify potential faults before they cause unexpected breakdowns. Robotics is also expanding sorting capabilities through automated picking and placement, particularly for delicate products that require individual handling.

Sustainability and flexibility are influencing equipment development. Energy-efficient designs, optimised compressed-air consumption and improved sorting accuracy help reduce operational costs and unnecessary material losses. Modular systems allow manufacturers to adapt equipment configurations, sensor combinations and processing capacities to different products and production volumes. Furthermore,



integrating sorting data with manufacturing execution systems (MES), enterprise resource planning (ERP) and quality management platforms strengthens traceability and supports data-driven production decisions.

Applications Across Food Processing

Sorting technologies have applications across several food manufacturing segments. In grains and pulses, optical, mechanical and NIR systems remove discoloured grains, stones and unwanted seeds. Fruit and vegetable processors use optical and multispectral technologies to identify damaged produce and selected quality variations. Nut and seed processors combine optical and laser sorting to remove defective kernels and certain foreign materials. Potato and snack manufacturers use automated sorting to eliminate green, damaged and discoloured products. In meat, poultry and seafood processing, X-ray inspection helps identify bones and other dense foreign bodies, while vision systems assess product appearance. Bakery, confectionery, dairy and packaged food manufacturers use X-ray and automated vision inspection to identify foreign materials, product defects and packaging inconsistencies.

Conclusion

Sorting technology has evolved from a basic grading operation into an important component of modern food safety, quality assurance and manufacturing automation. Optical cameras, laser sensors, X-ray inspection, mechanical grading and spectroscopy-based systems enable manufacturers to identify unwanted materials and product defects with greater precision and consistency. As AI, machine learning, hyperspectral imaging, robotics and industrial connectivity advance, sorting systems will become increasingly intelligent, flexible and data-driven. However, effective food safety requires these technologies to operate alongside hygienic processing, microbial and chemical testing, allergen management and validated quality control procedures. An integrated approach will help manufacturers improve product quality, reduce waste, increase productivity and strengthen consumer confidence.

Mr. Anand is a supporting editor to FBP magazine

Engineering Efficient Thermal Processing Solutions for Quality, Safety and Sustainability in Food Manufacturing



In an exclusive conversation with Food & Beverages Processing magazine, Mr. T. K. Radhakrishnan, Vice President – Food Systems Business Unit, HRS Process Systems Limited, discusses the evolving challenges in thermal processing and the importance of product-specific process engineering in modern food manufacturing. He shares insights into how food processors can achieve commercial sterility and extended shelf life while preserving the colour, flavour and nutritional quality of products. The conversation also explores advanced evaporation technologies, including Mechanical Vapour Recompression (MVR), strategies to minimise fouling and product damage, efficient handling of particulate-based foods, and opportunities to reduce energy, water and chemical consumption. He further highlights the critical technical and operational parameters manufacturers should consider when selecting thermal processing systems to improve productivity, product consistency and long-term operational efficiency.

Which thermal processing problems, such as uneven heating, fouling and short shelf life, do food manufacturers struggle with most today?

The biggest challenge is that thermal processing is not simply about achieving a target temperature. Manufacturers must achieve the right combination of temperature, holding time, flow behaviour and heat transfer, while also protecting the product's sensory and nutritional characteristics.

For products such as fruit pulps, sauces and high-viscosity beverages, these challenges become even more pronounced. Uneven heating can compromise product safety and consistency, while fouling reduces heat-transfer efficiency, increases energy consumption and eventually forces production stoppages for cleaning.

At the same time, manufacturers are under pressure to deliver longer shelf life without compromising colour, flavour and nutritional quality. The solution therefore lies in designing the complete thermal process, understanding the product characteristics - not just simply selecting a heat exchanger based on capacity. Product rheology, particle size, fouling tendency, required lethality, residence-time and material of construction, all need to be considered together.

How can fruit pulp and puree processors achieve commercial sterility and ambient shelf life without damaging colour and flavour?

The key is to achieve the required level of microbial inactivation with the minimum practical thermal exposure. Excessive heating can negatively affect colour, flavour, texture and nutritional attributes, particularly in sensitive fruit products. A well-designed continuous thermal process can provide precise heating and holding, followed by rapid cooling. This allows the processor to achieve the required commercial sterility while limiting the time the product spends at elevated temperatures.

Heat-exchanger selection is also critical. For products with pulp, fibres or suspended solids, the equipment must provide effective heat transfer without creating excessive shear or localised overheating. Precise temperature control, accurate holding-tube design and reliable instrumentation are equally important.

Ultimately, the objective is not simply a high processing temperature. It is controlled lethality with minimum product damage, validated for the specific product and process conditions.

How can juices and purees be concentrated to a higher Brix with low aroma loss and low steam consumption?

Concentration is an area where process design can make a significant difference to both product quality and operating cost. Conventional evaporation can involve substantial thermal exposure, which may lead to aroma loss and quality degradation, particularly when concentrating sensitive fruit products. A better approach is to optimise the evaporation process around temperature, residence time, vacuum conditions, heat-transfer efficiency and vapour utilisation. Multiple-effect evaporation can improve steam economy by reusing vapour energy across successive effects.

For applications where energy efficiency is a major priority, technologies such as Mechanical Vapour Recompression (MVR) can further reduce dependence on external steam by recovering and reusing the energy contained in the vapour. In addition to energy saving, the processor can adjust the evaporating temperature minimum to retain Product Caliber.

The right solution depends on the product, feed Brix, target Brix and throughput requirements. The objective should be to achieve the desired concentration with the lowest possible thermal shock and energy consumption, rather than simply maximising evaporation capacity.

High-viscosity, fibrous products foul heat-transfer surfaces and force frequent shutdowns. How can plants run longer production cycles?

Fouling is influenced by much more than the product temperature. Flow velocity, wall temperature, residence time, product composition, viscosity, turbulence and heat-transfer-surface characteristics all play a role.

For high-viscosity and fibrous products, the heat exchanger must be selected and designed to maintain effective product movement and heat transfer without creating excessive pressure drop or shear. Equipment geometry, channel design and operating conditions need to be matched to the product's rheology.

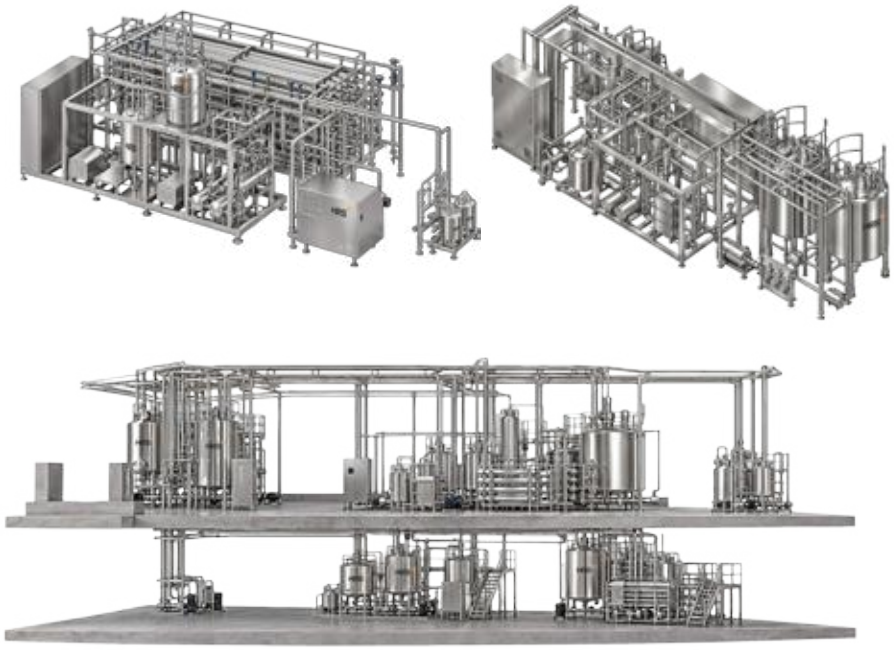
It is also important to avoid creating localised hot spots. Maintaining an appropriate temperature profile across the system can significantly reduce the tendency of the product to deposit on the heat-transfer surface.

Longer production cycles ultimately come from a combination of product-specific heat-exchanger design, optimal operating conditions and a well-engineered CIP strategy. The goal is to extend the time between cleaning cycles without compromising food safety or heat-transfer performance.

How can diced fruits, vegetables and ready-to-eat preparations be pumped and heat-treated without shearing or breakage?

Products containing particulates require a fundamentally different approach from homogeneous liquids. The objective is to move the product through the process while preserving the size, shape and texture of the individual pieces. This starts with selecting pumps that are appropriate for the product and minimising unnecessary pressure fluctuations and mechanical stress. The piping layout should also avoid sharp changes in direction, excessive velocity and restrictive components that can damage particulates.
On the thermal side, the system needs to provide uniform heat treatment without excessive agitation or recirculation. The heat exchanger, holding system and product velocity should therefore be designed around the particle size, concentration, density and fragility of the product.

For these applications, successful thermal processing means achieving food safety while treating the product as a combination of liquid and solids- not simply as a conventional fluid.



How can plants improve heat recovery and reduce steam, water and chemical consumption per tonne of product?

Energy and resource efficiency must be considered at the process-system level. Simply improving the efficiency of one piece of equipment may not deliver the best overall result. A well-designed process should maximise heat recovery between hot and cold product streams wherever product quality and hygiene requirements permit. Regenerative heating and cooling can substantially reduce the amount of external steam and cooling utilities required.

Similarly, efficient CIP design can reduce water, chemicals and cleaning time by optimising flow velocity, temperature, chemical concentration and cleaning sequence. Automation helps ensure that these parameters are consistently maintained rather than depending on manual intervention.

For evaporation applications, advanced technologies such as MVR can provide another significant opportunity to reduce energy consumption. The right metric is therefore not only equipment efficiency, but energy, water and chemical consumption per tonne of finished product. That is the metric that ultimately matters to a food manufacturer's operating cost and sustainability performance.

What technical parameters should a manufacturer evaluate before choosing a thermal processing system?

There are several parameters that should be evaluated, and they should be considered collectively rather than in isolation.

First is the product itself - viscosity, solids content, particle size, fibre content, pH, density, rheology and fouling characteristics. Then come the required process conditions: target temperature, holding time, required lethality, heating and cooling rates, throughput and operating range.

The manufacturer should also evaluate heat-transfer performance, pressure drop, allowable shear, product residence time, material of construction, hygienic design and cleanability. Utility consumption particularly steam, electricity, cooling water and CIP resources - should be assessed over the expected production cycle.

From a business perspective, factors such as footprint, automation, maintainability, uptime, future scalability and total cost of ownership are equally important. Most importantly, manufacturers should look beyond the individual equipment item. Thermal processing is part of an integrated process, and the best solution is one that balances food safety, product quality, energy efficiency, operational reliability and lifecycle cost.

At HRS, our approach is to work backwards from the customer's product and process requirements and engineer the appropriate solution around them. This integrated approach becomes increasingly important as food manufacturers look for safer, more efficient and more sustainable processing operations.

Alfa Laval launches new MaxiLobe rotary lobe pumps for higher efficiency and uptime, with lower total cost of ownership



A higher standard for demanding hygienic processes

Manufacturers in the dairy, food, beverage, home and personal care, and pharmaceutical industries are under constant pressure to improve efficiency, maximize uptime and reduce the total cost of ownership. The Alfa Laval MaxiLobe and MaxiLobe UltraPure pump ranges address these priorities through higher volumetric efficiency, a broader operating envelope, enhanced assurance and simpler service. "For decades, our rotary lobe pumps have been widely used in hygienic and high-purity processing where reliability and predictable performance are essential," says Russ Kelly, Portfolio Manager, Pumps at Alfa Laval. "MaxiLobe builds on that legacy with improved hygienic design across a wider operating range, enabling smaller pumps to achieve the same duty at lower speeds. Lower speeds reduce shear, helping improve operating efficiency and safeguard shear-sensitive products."

Optimized investment

MaxiLobe and MaxiLobe UltraPure pumps help optimize capital investment through high volumetric efficiency and an exceptionally broad flow and pressure envelope. Additionally, by enabling a smaller pump to be selected for the required duty in suitable applications, MaxiLobe can reduce equipment and installation costs, including the associated electrical equipment. This reduces the need for oversizing while maintaining operational flexibility. Upgrades are equally straightforward. Key porting dimensions match those of all Alfa Laval SRU pumps and most SX and SX UltraPure models, allowing replacement without modifying existing pipework. Under defined operating conditions, MaxiLobe delivers at least 5% higher flow rates than the equivalent SRU model, improving process capacity without increasing footprint or installation complexity.

Cost-effective operation

MaxiLobe and MaxiLobe UltraPure pumps can deliver the required flow rates at lower operating speeds, helping reduce energy consumption and electricity costs. In many applications, this can result in energy savings of more than 25%. Operating the pumps at lower speeds also reduces shear on sensitive products that may be damaged when operating at higher speeds. By reducing mechanical stress, MaxiLobe pumps can help extend service intervals and equipment life. A robust gearbox design supports reliable performance under demanding conditions, reducing the risk of unplanned stoppages and supporting more predictable, resource-efficient operation and lower lifecycle costs.

Enhanced assurance

MaxiLobe and MaxiLobe UltraPure pumps protect product quality and reduce cross-contamination risk through precision-profiled elastomers, superior cleanability and hygienic and high-purity design. MaxiLobe provides both EHEDG and 3-A certification alongside full FDA compliance as standard, delivering an uncompromised hygienic solution. For pharmaceutical and biotech applications, MaxiLobe UltraPure complies with ASME BPE standards and Good Manufacturing Practices guidelines. It offers material options, enhanced surface finishes and product-wetted materials conforming to FDA and USP requirements. Comprehensive Alfa Laval Q-doc documentation provides full traceability and validation support for use in regulated manufacturing environments. Every pump is factory-tested and supplied with a performance certificate confirming that it meets its specified operating curve before delivery, ensuring reliable commissioning and smooth start-up.

Simpler service

MaxiLobe and MaxiLobe UltraPure are engineered for quick, predictable maintenance. Front-loading single seals can be replaced without removing the pump from the process line, reducing downtime during routine service. Interchangeable components and easily accessible shimming simplify servicing and help reduce maintenance time. Alfa Laval's global service organization further supports maintenance wherever the pumps are installed.

Alfa Laval MaxiLobe and Alfa Laval MaxiLobe UltraPure.

Key Technology Introduces New Enhancements for COMPASS® Optical Sorters



Key Technology, a member of the Duravant family of operating companies, has introduced new enhancements to its COMPASS® belt-fed optical sorter to improve sorting accuracy, product recovery and production efficiency across snacks, vegetables and other food applications. The upgrades include advanced pulsed LED backlight technology, optional three-way sorting and a new high-capacity B200 model featuring a 2-metre-wide sorting belt.

The advanced backlight technology, available in visible and near-infrared wavelengths, transmits light through the conveyor belt to improve product segmentation, reduce shadows and minimise the effects of belt staining, enabling more consistent detection of defects and foreign materials, particularly in challenging applications such as kettle chips. The optional three-way sorting system adds a second ejection manifold, allowing processors to separate products into three independently configurable streams in a single pass for product recovery, defect classification or grading. This can eliminate the need for additional sorting equipment or manual inspection, reducing labour requirements and improving yield. Meanwhile, the new B200 model is designed for high-throughput production lines, enabling processors to achieve required capacities with a single sorter while simplifying line configurations.

According to Gina Maria Bonini, President of Key Technology, the enhancements reflect customer feedback and address practical operational requirements without increasing complexity for production teams. All COMPASS sorters feature advanced sensing technologies, recipe-driven operation and a hygienic, open design for easier cleaning and maintenance. They are also equipped with Key Discovery™, analytics and reporting software that provides actionable production data to help processors monitor and improve operational performance.

www.key.net/en/our-products/sorting.

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Engineering Packaging from Fruit Waste: Innovations in Bioplastics, Nanocellulose and Compostable Materials

Amarpreet Singh



Introduction

The growing demand for sustainable packaging is encouraging the food and beverage industry to explore alternatives to conventional petroleum-based plastics. Rising concerns over plastic pollution, carbon emissions and packaging waste have accelerated research into renewable, biodegradable and compostable materials. Among the emerging resources, fruit processing waste is gaining attention as a valuable raw material for developing next-generation packaging solutions.

The fruit processing industry generates substantial quantities of peels, seeds, pulp and pomace during juice extraction, canning, drying and puree production. Traditionally, much of this waste has been discarded, sent to landfills or used for low-value applications such as animal feed and composting. However, these residues contain valuable natural polymers, including pectin, starch, cellulose, hemicellulose and lignin, which can be recovered and converted into films, coatings, fibres and biodegradable packaging materials.

Advances in biopolymer extraction, nanocellulose production and material engineering are making it increasingly possible to transform these residues into functional packaging. By recovering these components and combining them with other bio-based materials, researchers are developing solutions with improved mechanical strength, flexibility, barrier properties and end-of-life characteristics. This approach also supports a circular economy by creating additional value from food industry by-products.

Unlocking Packaging Potential from Fruit Processing Waste

Different fruit residues offer different material properties. Citrus peels, particularly from oranges, lemons and grapefruits, are rich in pectin and cellulose. Apple pomace contains pectin, dietary fibre and cellulose, while banana peels provide starch and cellulose. Mango peels and seeds contain pectin, starch and fibres, whereas pineapple leaves and processing residues are valuable sources of natural cellulose fibres. Grape pomace contains lignocellulosic components and antioxidant compounds. The conversion process begins with collecting, washing, drying and reducing the residues to suitable particle sizes. Depending on the intended application, the biomass undergoes mechanical, thermal, chemical or enzymatic treatments to isolate specific components. Modern extraction techniques aim to improve recovery efficiency while reducing chemical consumption, processing time and energy requirements. The recovered materials can be processed individually or combined with other biopolymers to manufacture packaging films, protective coatings, moulded products and composite structures.

Pectin-Based Films and Edible Packaging

Pectin is one of the most promising natural polymers recovered from citrus peels and apple pomace. Widely used in food manufacturing as a gelling, thickening and stabilising agent, pectin also possesses film-forming properties that make it suitable for biodegradable packaging.

Extraction generally involves treating fruit peels or pomace with hot water under controlled acidic conditions, followed by filtration, precipitation, purification and drying. Emerging technologies such as ultrasound-assisted, microwave-assisted and enzyme-assisted extraction are improving recovery efficiency while reducing processing time and solvent requirements. Extracted pectin can be converted into thin films through solution casting and coating processes. However, pure pectin films can be sensitive to moisture and may have limited mechanical strength. Researchers are addressing these limitations by blending pectin with starch, cellulose, chitosan and alginate. Plasticisers such as glycerol and sorbitol are also incorporated to improve flexibility and reduce brittleness.

These formulations offer potential applications in fresh produce packaging, food wraps, sachets and protective coatings. Pectin-based edible coatings can also be applied directly to fruits and vegetables to reduce moisture loss and help maintain freshness during storage.
Another promising development is active packaging, in which natural antioxidant and antimicrobial compounds recovered from fruit residues are incorporated into pectin films. Phenolic compounds from grape pomace and citrus peel extracts, for example, can provide antioxidant functionality, helping delay oxidation and support food preservation.

Starch-Based Bioplastics from Fruit Residues

Starch is another important natural polymer that can be recovered from fruit processing by-products. Banana peels, mango kernels and avocado seeds are potential sources of starch for biodegradable packaging applications. The production process involves separating starch from the biomass, followed by gelatinisation and thermoplastic processing. During gelatinisation, heat and water disrupt starch granules, allowing polymer chains to form a continuous structure. Plasticisers such as glycerol are added to improve flexibility and processability.
Thermoplastic starch (TPS) can be manufactured using extrusion, compression moulding and film-blowing technologies. These processes offer opportunities to produce flexible films, bags, pouches, trays and protective packaging components.

However, starch-based materials generally have limited moisture resistance and can become brittle under certain storage conditions. Researchers are addressing these limitations through polymer blending, cross-linking and surface modification. Combining starch with pectin, cellulose or biodegradable polymers such as polylactic acid (PLA) can improve mechanical strength and functional properties.

The use of fruit-derived starch also provides an opportunity to utilise processing residues instead of relying exclusively on conventional starch crops. However, extraction yield, raw material consistency and purification costs remain important considerations for commercial production.

Nanocellulose: Strengthening Sustainable Packaging

Cellulose recovered from fruit peels, pomace and pineapple residues offers considerable potential for developing high-performance packaging materials. Through purification and specialised processing, natural cellulose fibres can be converted into microcellulose and nanocellulose. Two important forms are cellulose nanocrystals (CNCs) and cellulose nanofibrils (CNFs). CNCs are highly crystalline, rod-shaped particles, while CNFs consist of long, flexible fibrils with nanoscale diameters. Both offer high strength-to-weight ratios and can reinforce biodegradable polymer matrices.

Emerging technologies such as high-pressure homogenisation, microfluidisation, ultrasonication and enzymatic pretreatment help break down cellulose fibres into nanoscale structures. These processes produce materials with high surface areas and strong interactions with surrounding polymers.

When incorporated into pectin-, starch- or PLA-based films, nanocellulose can improve tensile strength, structural stability and gas barrier performance. It can also help reduce the quantity of polymer required in certain composite formulations. Nanocellulose-based coatings are being investigated for paper packaging, flexible films and protective layers for fresh produce. Achieving uniform dispersion of nanocellulose within polymer matrices remains essential, as poor dispersion can affect mechanical performance, transparency and the consistency of the finished packaging.

Fibre-Based Composites and Moulded Packaging

Beyond extracting individual polymers, fruit waste can also be processed into fibre-based composites for rigid and semi-rigid packaging. Banana peels, pineapple residues, mango fibres, citrus peels and apple pomace contain lignocellulosic materials that can be incorporated into moulded products. The process involves drying and grinding the residues, followed by fibre separation and treatment. These fibres can be blended with starch, pectin or other biodegradable binders to produce mouldable composites. Compression moulding, hot pressing and thermoforming are among the techniques used to develop trays, containers, protective inserts and cushioning materials.

Natural fibres contribute structural strength while reducing dependence on synthetic reinforcing agents. Their performance depends on fibre length, moisture content, surface characteristics, binder compatibility and processing temperature. Another approach involves incorporating dried and finely milled fruit residues directly into biopolymer formulations. This can reduce the need for extensive purification and multiple processing stages. However, moisture content and variations in raw material composition must be controlled to ensure consistent product quality.

Advanced Processing and Active Packaging Technologies

Several emerging processing technologies are improving the recovery and conversion of fruit waste into packaging materials.

- Ultrasound-assisted extraction: Uses high-frequency sound waves to generate cavitation, disrupting plant tissues and releasing pectin and other valuable compounds while reducing extraction time.
- Microwave-assisted extraction: Uses controlled heating to accelerate cell-wall disruption and improve the recovery of natural polymers.
- Enzyme-assisted extraction: Uses specific enzymes to break down plant cell-wall components, enabling polymer recovery under relatively mild processing conditions.
- Extrusion and thermoplastic processing: Enables the blending of starch, cellulose, plasticisers and biodegradable polymers to produce continuous films, sheets and mouldable compounds.
- Electrospinning: Uses an electric field to produce extremely fine polymer fibres, which are being investigated for active packaging, filtration and protective layers.

Fruit waste also provides natural bioactive compounds such as polyphenols, flavonoids, anthocyanins and essential oils. These can be incorporated into biopolymer films to provide antioxidant, antimicrobial and freshness-indicating functionality.

For example, anthocyanins extracted from fruit skins change colour in response to pH variations. When incorporated into packaging, they can act as visual indicators of changes associated with food spoilage. Such intelligent packaging could support freshness monitoring in meat, seafood and dairy products, although its performance must be validated under specific storage conditions.

Challenges in Commercialisation

Despite their potential, fruit waste-based packaging materials face several technical and commercial challenges. Moisture sensitivity remains a major limitation of pectin- and starch-based films, affecting their mechanical stability and water vapour barrier performance. Polymer blending, cross-linking, surface modification and nanocellulose reinforcement are among the approaches being investigated to address these limitations.

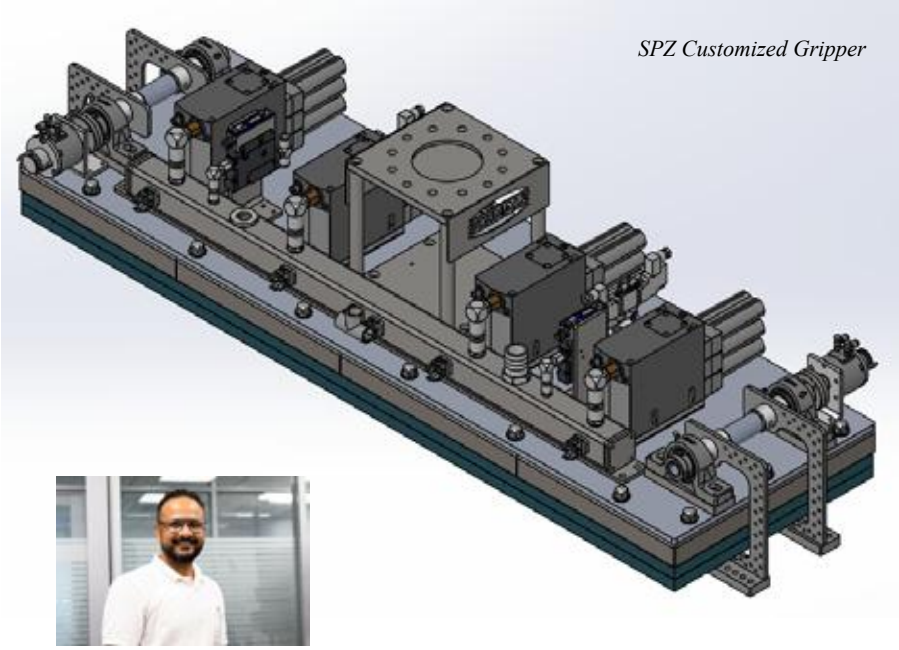
Raw material variability is another concern, as fruit composition changes according to variety, maturity, growing conditions and processing methods. Industrial production also requires efficient waste collection, transportation, drying, extraction and purification systems. Manufacturers must consider the energy consumption, chemical requirements and overall economics of these operations. Food-contact safety is equally important. Packaging materials intended for direct food contact must undergo appropriate migration, toxicity, chemical stability and microbiological assessments. Furthermore, biodegradability and compostability claims must be supported by relevant testing. A material suitable for industrial composting may not necessarily degrade effectively in home composting environments.

The Road Ahead

The conversion of fruit processing waste into bioplastics, nanocellulose and compostable packaging offers an important opportunity to connect food processing with sustainable material manufacturing. Citrus processors could recover essential oils and pectin from peels before utilising the remaining fibrous material for cellulose extraction or composite production. Similarly, banana peels, mango residues and apple pomace could become valuable feedstocks for starch-, fibre- and biopolymer-based packaging.

The next stage of development will depend on improving extraction efficiency, standardising raw materials, optimising polymer formulations and establishing economically viable manufacturing processes. Collaboration between fruit processors, packaging manufacturers, material scientists and research institutions will be essential to scale these innovations. Although fruit waste-derived materials are not yet universal replacements for conventional plastics, their potential applications in flexible films, protective coatings, trays, moulded containers and active packaging make them an important area of industrial research. Ultimately, engineering packaging from fruit waste represents more than an alternative to petroleum-based plastics. It offers an opportunity to transform food processing residues into valuable resources and build a more circular, resource-efficient packaging industry.

Unlocking Productivity through the Right Gripping Solutions



SPZ Customized Gripper

Mr. Narendra Marathe
Industry Segment Manager – Robotics

When I visit manufacturing facilities across India, regardless of the industry, I often hear the same concerns from production and plant teams. They are expected to produce more, maintain quality, reduce downtime, and handle a growing variety of products, all while meeting tight delivery schedules. These are real challenges that impact day-to-day operations, and this is one of the key reasons why robotics is gaining momentum across Indian manufacturing. A few years ago, most discussions around automation were focused on whether companies should invest in robotics. Today, the conversation has changed. Manufacturers have already seen the benefits of automation. What they want to understand now is how robotics can help them solve specific production challenges, whether it is labour availability, quality consistency, higher throughput, or handling products that are difficult to manage manually.

As we move towards 2027, I believe robotics will become a standard part of operations across many industries, including automotive, electronics, logistics, packaging, warehousing, and battery manufacturing. However, simply installing a robot does not guarantee success. The real challenge is creating a solution that fits the application and delivers measurable improvements on the shop floor.

One of the most common challenges I see is product handling. Manufacturers are dealing with products that vary in size, shape, weight, packaging format, and surface characteristics. Production lines often need to handle multiple product variants while maintaining speed and accuracy. Even a small handling issue can lead to downtime, product damage, quality concerns, or reduced productivity.

This is why I always say that customers are not investing in robots or grippers; they are investing in better productivity, reliability, and process efficiency. To achieve those objectives, every part of the automation system must work together seamlessly.

A recent project perfectly demonstrates this approach. One of our customers was operating a high-volume palletizing line and facing challenges in handling carton boxes with different dimensions and weights. The process required high cycle rates, accurate placement, and reliable gripping despite variations in carton size and load distribution. Conventional gripping methods were struggling to provide the consistency needed for stable operation.

Instead of recommending a standard solution, our team started by studying the application in detail. We evaluated carton dimensions, center-of-gravity variations, surface characteristics, payload requirements, robot dynamics, and cycle-time targets. Only after understanding the complete process did we begin designing the solution.

Based on our findings, we developed a fully customized SPZ gripping solution engineered specifically for the customer's application. The suction cup arrangement, vacuum flow characteristics, gripping area, and gripper structure were optimized to accommodate multiple carton formats while ensuring secure handling throughout the process. At the same time, we carefully managed the overall gripper weight to maintain robot speed and performance without compromising reliability.

The result was a more stable and repeatable handling process. The customer achieved improved placement accuracy, reduced downtime, and higher overall productivity. For me, this project highlights an important lesson: the biggest gains in automation often come from solving the actual process challenge rather than focusing solely on the equipment itself.

Looking ahead, I believe manufacturers will increasingly demand automation systems that are flexible enough to adapt to changing products and production requirements. The factories of the future will require solutions that deliver both efficiency and adaptability. This will make application-specific engineering even more important.

At Schmalz, our role goes beyond supplying gripping technology. We work closely with customers to understand their production challenges and develop solutions that support their operational goals. Whether the application involves cartons, sheet metal, batteries, electronics, consumer goods, or warehouse logistics, the objective remains the same: improving productivity, reliability, and process performance.

In my experience, the most successful automation projects are those that begin with a clear understanding of the challenge. When the right handling solution is designed around the application, manufacturers can improve throughput, reduce rejects, minimize maintenance, and achieve greater value from their automation investment.

As robotics adoption continues to grow in India, companies that focus on solving real production challenges rather than simply adopting technology will see the greatest benefits. Robotics has enormous potential, but its true value is realized when it helps manufacturers build more efficient, reliable, and future-ready operations.

"Every automation challenge is an opportunity for robotics"

Schmalz India Private Limited

SIG introduces new high-speed,
high-flexibility SIG Neo filling machines for aseptic cartons



SIG is further expanding its state-of-the-art SIG Neo filling machine portfolio for aseptic cartons, responding to the food and beverage industry's pressing need for high output and highly flexible production without costly facility expansion.

The two new additions to the SIG Neo platform – SIG Neo XSlim 32 Aseptic for single-serve cartons and SIG Neo Midi 15 Aseptic for multi-serve cartons – deliver both, speed and flexibility, in compact machine footprints. SIG Neo XSlim 32 Aseptic can fill 32,000 SIG XSlimBloc single-serve cartons per hour in 9 different pack sizes, while SIG Neo Midi 15 Aseptic fills 15,000 SIG MidiBloc or SIG MidiFit popular squarish multi-serve cartons per hour, each in three different pack sizes. The new filling machines boost both total output and output per square meter by one-third while offering the same unmatched SIG flexibility with pack size or format changes respectively done in minutes.

"Many food & beverage producers have reached the physical limits of their existing plants. SIG Neo filling machines deliver highest output per sqm in the industry and therefore add capacity to our customer's factories and not buildings," said Christoph Wegener, Chief Markets Officer at SIG.

Leveraging SIG's sleeve-based carton technology and open-sleeve filling process, SIG Neo XSlim 32 Aseptic can handle up to nine single-serve pack sizes on one machine, while SIG Neo Midi 15 Aseptic runs two formats, SIG MidiBloc and SIG MidiFit, each of them with three multi-serve pack sizes. Operators can switch between pack sizes, formats in less than 15 minutes without changing any machine parts – all this while maintaining the same compact footprint that manufacturers are familiar with from SIG's standard filling machines. This enables rapid SKU changes, reduced downtime, lower investment costs and greater responsiveness to market demand.

Both new SIG Neo filling machines offer an industry-leading waste rate of less than 0.5%, smart digitalization in operations, and reduced Total Filling Costs compared to SIG's standard filling machines for these formats.

Additional technical innovations and advancements of the new SIG Neo filling machines include the state-of-the-art SIG Neo HMI (Human-Machine Interface) for intuitive operation and smart performance insights and SIG Neo Shield for enhanced sterile airflow and shielding during bottom sealing and pre-folding, removing up to 95% of particles from the air.

"The latest additions to our SIG Neo platform demonstrate how innovation can translate directly into operational value," said Gavin Steiner, Chief Technology Officer at SIG. "By combining speed, flexibility, advanced digital capabilities and aseptic excellence, we have created filling solutions that not only increase productivity but also simplify day-to-day operations."

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Evodeco® Next: Sidel Brings New Freedom and Material Efficiency to Roll-Fed Labelling



Sidel has introduced EvoDECO® Next, its next-generation roll-fed labelling solution, combining high-performance production with greater decoration freedom and significantly lower material consumption. By bringing partial labels to a roll-fed platform, it enables beverage producers to use less label material while revealing more of the bottle for differentiated, premium brand expression, without compromising the robustness required for industrial production.

"EvoDECO Next rethinks what is possible with roll-fed labelling. Producers no longer need to choose between industrial efficiency, material reduction and impactful decoration. By enabling partial labels on a simplified roll-fed architecture, we can help customers use less material, create new brand opportunities and maintain the performance their production lines demand," said Anne Philippe Lafon, Product Manager – Labelling, at Sidel.

Responding to the evolution of PET packaging

PET packaging continues to evolve towards greater material efficiency and circularity, while brands remain under pressure to differentiate on shelf. Much of the industry's lightweighting work has focused on the bottle itself, from the neck and body to the base. EvoDECO Next extends this thinking to decoration, treating the label as another packaging component that can be optimised.

Traditionally associated with wraparound decoration, roll-fed labelling can now be used with smaller partial labels through EvoDECO Next. By revealing more of the bottle, producers can make the container shape, transparent PET and product part of the visual identity. The result is a premium aesthetic that also reduces the amount of label material required.

Less material, greater brand impact

Depending on the decoration selected, Sidel says partial labelling can reduce label surface by up to 75% compared with a conventional wraparound label. The maximum figure is based on its illustrated 90° partial-label configuration, while a 180° configuration reduces label surface by 50%.

For high-volume producers, partial labelling can deliver significant savings. In one Sidel example, moving from a full wraparound label to a 90° partial label reduced BOPP consumption by 208.4 tonnes per year, cut associated CO_2 emissions by 346 tonnes and generated approximately €723,000 in annual raw material savings.[1]

The approach also supports Sidel's broader JUST label proposition, combining sustainability, branding, lower total cost of ownership and simpler technology. By making the uncovered bottle an intentional part of the design, producers can now cut material while retaining strong shelf appeal.

Integrated technology to simplify high-performance production

EvoDECO Next has been engineered as an integrated platform, rather than an existing roll-fed machine adapted for shorter labels. Its architecture combines Cutter 2.0, Smart Buffer, Smart Camera and High-Speed changeover parts, with feeding, cutting, transfer and control designed to work seamlessly together. At the heart of the new partial-labelling capability is the new cutting system, positioned directly on the transfer drum. The rotary cutting device handles shorter labels using two blades cutting faster at high speed.

The Smart Buffer is designed to absorb reel changes without variation in production speed. Its lean configuration requires no additional footprint or changes to the standard film path and allows the splicing operation to be managed at the nominal speed, helping protect overall production efficiency.

Meanwhile, the Smart Camera enables reference-mark-free label management. Removing the conventional reference mark and quiet zone increases raw-material and label flexibility, while creating further opportunities for material savings. Dedicated software supports autocorrection, improved auto-homing and enhanced diagnostics.

New high speed Changeover parts further support machine autonomy and process robustness. An optimised sliding surface and air-blade system are designed to minimise glue cross-contamination and label stress, helping extend machine autonomy by up to five times while reducing related unplanned stops.

Simplifying operations from reel to label

EvoDECO Next can also be combined with Sidel's CoboREEL® automated reel-management solution, which reduces operator intervention, provides embedded traceability and supports greater production autonomy, of up to 18 reels. Across the labelling station, Sidel has also simplified key elements to support faster, changeovers, easier maintenance and consistent uptime.

Building on 50 years of Sidel labelling expertise, more than 330 EvoDECO machines sold since launch and over 5,000 Sidel labellers installed worldwide, EvoDECO Next extends packaging optimisation beyond the PET bottle, helping producers make every label count through less material, greater decoration freedom and simplified production.

To find out more, including how businesses can access this support, visit the Sidel website.

[1] Calculation assumptions: Based on a 61,000 bottles-per-hour production line producing approximately 459 million bottles annually. Label surface area reduced from 20,160 mm² to 5,040 mm² per bottle by moving from a full wraparound label to a 90° partial label configuration. CO_2 and cost savings are based on Sidel modelling assumptions and may vary depending on product, material specification and operating conditions.

Competek Launches Universal Mould for Multiple Blow Moulding Platforms



Competek has introduced Flex Mould, a universal blow mould designed to help manufacturers simplify mould management across mixed blow moulding environments. Compatible with most leading blow moulding machines, Flex Mould uses a dedicated interface system that allows the same mould to be transferred between compatible platforms, reducing the need for machine-specific tooling.

The solution builds on Competek's more than 25 years of experience in PET packaging, including custom mould development for different lines and brands, as well as mechanical and laboratory testing to support feasibility and performance.

This technology comes as PET packaging producers face growing pressure to manage more product variants, shorter production runs and more frequent changeovers. Industry reports point to SKU proliferation, lightweighting, recycled-content requirements and cost pressure as forces reshaping packaging operations, placing greater value on adaptable production assets.

"Flex Mould was developed around a simple concept: one mould that can be used across multiple compatible machines," said Olivier Dacquignie, Manufacturing Director at Competek. "By combining the mould with a dedicated interface system, manufacturers can reduce reliance on machine-specific tooling while retaining the flexibility to respond quickly to production needs."

"The ability to transfer a mould between compatible machines also provides an effective backup solution during maintenance operations or unexpected downtime, helping



to support operational continuity."

Flex Mould also supports faster format changeovers through a tool-free replacement system. By eliminating the need for tools during mould replacement, it is designed to reduce setup times and make it easier to move production between compatible machines when required.

Using one mould across multiple machines can also reduce the number of moulds a manufacturer needs to purchase, manage and store. This can help lower initial investment and ongoing operating costs, while freeing up space in production and warehouse areas. Flex Mould is designed to give manufacturers more choice in how they deploy mould assets across compatible blow moulding platforms.

About Competek

Competek leads on innovative custom solutions for PET packaging with over 25 years of experience. Specialising in developing custom moulds for all lines and brands, Competek guarantees feasibility and performance through both mechanical and laboratory tests. The company offers a comprehensive set of solutions through one touch points, expertise, and customer-oriented lifetime services, ranging from packaging and preform design and development, to engineering, moulds, line conversion, quality checks, training, consultancy and after sales.

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3 - 5, Dec - 2026
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Annapoorna Inter Food - 2026
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Bombay Exhibition Centre, Mumbai

PackVision Expo - 2027
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PIECC, Moshi, Pune

Inter FoodTech - 2027
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Bombay Exhibition Centre, Mumbai

Anuga FoodTec Dairy - 2027
28 - 30, April - 2027
Bharat Mandapam, New Delhi

India Foodex - 2027
20 -22, Aug - 2027
KTPO, Bangalore

16th DairyTech India - 2027
20 -22, Aug - 2027
KTPO, Bangalore

PackTech India - 2027
20 -22, Aug - 2027
KTPO, Bangalore

Anuga FoodTec India - 2027
26 -28, Nov - 2027
BEC, Mumbai

Anuga Select India - 2027
26 -28, Nov - 2027
BEC, Mumbai

Bharat Packaging Expo - 2027
30 Aug - 1 Sept - 2027
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Challenges in the Coffee Market – Opportunities for Coffee Packaging?





Rising green coffee prices, changing consumer habits, greater price sensitivity, and now the PPWR – the coffee industry is undergoing far-reaching change. But given the increasingly challenging market conditions, how can packaging for ground coffee and whole beans be made fit for the future? How can production efficiency and brand appeal be improved? How can regulatory risks be reduced? And finally, which trends are currently shaping the market?

SÜDPACK has explored these very questions, identifying key drivers and trends in the coffee market. SÜDPACK is more than a family-owned manufacturer of films and packaging. Drawing on its expertise in extrusion and materials, years of project experience, and comprehensive services, it also acts as a development partner, working with customers to drive the transition from conventional laminates to packaging concepts designed for recyclability.

The coffee market at a glance

The coffee market is one of the largest and most stable food markets worldwide. Europe is currently the largest market, accounting for around 30% of global coffee consumption, with an estimated market value of approximately USD 56 billion in 2026 and an average annual growth rate of over 5%. Germany accounts for the largest share of the European coffee market, with coffee consumption of 456,000 metric tons and turnover of nearly EUR 9 billion in 2025[1]. However, the industry is also changing – from new consumer groups and markets to coffee products and packaging sizes.

Ground coffee remains a major market segment, but whole beans are becoming increasingly popular. And although rising coffee prices, volatile raw material markets, climate change, and growing global demand are increasingly reinforcing coffee's image as a premium product to be savored, it remains a familiar pleasure enjoyed by people from all walks of life.

The industry's growing international reach and increasingly diverse consumer preferences are also driving these developments. Major coffee roasters are increasingly looking beyond their traditional markets for growth. Some are tailoring their offerings to regional preferences, while others are attracting consumers with a wide variety of coffees, exotic blends, or innovative product categories such as coffee concentrates, ready-to-drink products, functional coffee, collagen coffee, and high-protein coffee.

Current packaging trends

While 1-kg packs of whole beans and traditional 500-g vacuum packaging for ground coffee remain standard, smaller formats, such as 250-g packs, are becoming increasingly popular. Modified atmosphere packaging (MAP) for ground coffee is also gaining traction in certain segments.

The market is also shifting away from ground coffee toward whole beans. Whole beans are currently the strongest-performing segment in Germany, with sales reaching record highs. Why? One in three households already owns a fully automatic coffee machine – a reflection of how much people value a good cup of coffee.

With coffee prices high and consumers' purchasing power reduced, flexible packaging concepts, rapid design changes, small print runs and pack sizes, and new price points are becoming key competitive factors. At the same time, packaging is becoming a brand ambassador in its own right, helping to showcase coffee's premium appeal. High print quality, haptic lacquers, and matte or gloss effects are reinforcing this premium positioning and helping win over discerning consumers.

For film manufacturers such as SÜDPACK, the implications are clear: Packaging must adapt to changing trends, provide reliable product protection to preserve the coffee's aroma, freshness, and shelf life, and meet consumer expectations for a premium product.

Recyclability, processing, and product protection – finding the right balance

The PPWR is accelerating an industry-wide shift in packaging away from conventional laminates, with or without aluminum, toward PP- or PE-based mono-material structures. Established recycling streams for both polymers already exist in many European countries. This raises a number of important questions for most coffee roasters and packers: Which films can be processed efficiently on existing machines while maintaining high throughput? How can optimal product protection be ensured? And how can regulatory and business risks be minimized?

The barrier properties of a new packaging material must match the high level of protection provided by conventional aluminum laminates, which shield the characteristic aromas developed during roasting from oxygen, light, and moisture and play a key role in preserving product quality.

CarbonLite®: PP-based packaging solution for coffee

SÜDPACK's CarbonLite® product family offers a packaging concept that seamlessly combines product safety and performance with high-quality design optimized for recyclability. With its PP-based Flow Pack, the film manufacturer offers a high-performance film that can enter established recycling streams in many European countries.

This mono-PP laminate can be processed on existing vertical form-fill-seal (VFFS) machines and offers high sealing performance and sealing strength. The material can be equipped with effective barriers against oxygen, water vapor, and UV radiation. It also offers high rigidity, good puncture resistance, and resistance to substances such as oils. PP-based aroma protection valves can also be easily heat-sealed into the packaging, allowing the coffee to degas after roasting.

In addition to its PurePP film, SÜDPACK offers a metallized version that makes metallic effects in the print image stand out. Even without metallic effects, both materials can be enhanced with vibrant print images, using flexo print, rotogravure printing, or digital printing to suit the application and customer preferences. Another option is SÜDPACK's SPQ® printing technology. Its standardized seven-color (7C) color space and fixed process parameters ensure high quality and consistent printing results while reducing ink and solvent consumption.

Solid evidence, reliable implementation

SÜDPACK supports customers as they transition to new packaging concepts, providing film solutions tailored to their requirements and backing up its developments with solid evidence. An internal screening of coffee packaging shows that replacing a conventional 100-µm-thick PET/aluminum/PE laminate with CarbonLite PurePP film of the same thickness can reduce the overall carbon footprint by 43%. The calculation tool was developed in accordance with ISO 14040/44, and the figures are based on a cradle-to-grave approach that excludes printing and the use phase. End-of-life treatment is accounted for using the German recycling mix.

SÜDPACK also supports producers at every stage of the development process, from the initial idea through to final implementation. The aim is to minimize the risks associated with the transition, ensure that new packaging concepts can be reliably integrated into existing production processes, and, above all, deliver greater flexibility, faster time-to-market, and future-ready packaging concepts with strong market appeal.

[1] Source: German Coffee Association, European Coffee Market Size, Share, and Growth Overview, 2031

About SÜDPACK

SÜDPACK is a leading manufacturer of high-performance films and packaging solutions for the food, non-food, and medical goods industries, as well as customer-specific compounds for technically demanding applications.

The family business, which was founded by Alfred Remmele in 1964, is headquartered in Ochsenhausen. The production sites in Germany, France, Poland, Switzerland, and the Netherlands are equipped with the latest plant technology and manufacture to the highest standards, including the capacity to operate under clean room conditions. The global sales and service network ensures a high degree of proximity to the customer and comprehensive technical support in more than 70 countries.

With its innovative Development and Application Center at its headquarters in Ochsenhausen, SÜDPACK offers its customers an optimal platform for developing tailor-made solutions and performing application tests.

SÜDPACK is committed to sustainable development and fulfills its responsibility as an employer and towards society, the environment and its customers. For its sustainable product developments and consistent commitment to a functioning circular economy in the plastics industry, SÜDPACK has received numerous awards. Further information is available at suedpack.com



Beyond Taste: How Science and Technology are Redefining Food Flavour Innovation

Aakansha Singh



Flavour innovation is reshaping the food and beverage industry as changing consumer preferences drive demand for healthier, natural and more distinctive taste experiences. Advances in food science, biotechnology, fermentation and AI are creating new opportunities for product development. From clean-label formulations and plant-based foods to sugar reduction and globally inspired flavours, manufacturers are exploring new ways to improve taste and product appeal. The focus is on balancing innovation, sensory quality, nutritional expectations and sustainability.

Introduction: How Flavour is Shaping the Future of Food

Flavour has long been a defining element of the food and beverage experience, influencing consumer preferences, purchasing decisions and brand loyalty. As eating habits and lifestyle choices continue to evolve, manufacturers are facing growing demand for products that combine appealing taste with health, convenience, authenticity and sustainability. This shift is making flavour innovation an important part of food product development, encouraging companies to move beyond conventional taste profiles and explore new ingredients, formulations and processing techniques. Food science, biotechnology and advanced ingredient technologies are playing an increasingly significant role in developing flavours that meet changing consumer expectations while maintaining product quality, consistency and sensory appeal.

From plant-based meat alternatives and reduced-sugar beverages to fermented foods, functional snacks and globally inspired cuisines, flavour innovation is creating new opportunities across food and beverage categories. Manufacturers are exploring natural flavouring ingredients, botanical extracts, fermentation techniques and emerging technologies to develop distinctive taste profiles and address formulation challenges. At the same time, maintaining flavour stability during processing and storage, reducing undesirable notes in plant-based products and achieving the desired taste in healthier formulations remain key considerations. The growing application of flavour science and technology is therefore transforming product development strategies, positioning flavour as more than just a sensory attribute. It has become a strategic tool for product differentiation, consumer engagement and long-term competitiveness in an increasingly dynamic food and beverage market.

Changing Consumer Preferences Drive Flavour Innovation

Consumer expectations are becoming more diverse, shaped by greater exposure to international cuisines, digital food culture, health awareness and demand for convenient eating experiences. While familiar flavours continue to attract consumers, there is growing interest in products that offer novelty, regional authenticity and unexpected combinations. This is encouraging manufacturers to experiment with flavour profiles that combine traditional ingredients with contemporary culinary influences.

Sweet-and-spicy combinations, citrus paired with herbs, smoky notes in plant-based foods and savoury ingredients incorporated into snack products illustrate how manufacturers are expanding their flavour portfolios. Regional Indian ingredients such as kokum, tamarind, curry leaves, cardamom, kokum, black pepper and indigenous chillies also offer opportunities to develop products with distinctive identities for domestic and international markets.

At the same time, consumers are not necessarily looking for novelty at the expense of familiarity. Successful products often balance new sensory experiences with recognisable flavours. For manufacturers, the challenge is to introduce innovation while ensuring that the finished product meets expectations for aroma, taste, mouthfeel and aftertaste.

Natural Flavours and Clean-Label Formulations Gain Importance

The demand for simpler ingredient lists and greater transparency is influencing flavour formulation strategies. Food manufacturers are increasingly examining natural flavouring substances, botanical extracts, spices, herbs, fruit concentrates and other ingredients that can support product positioning while delivering consistent sensory performance.

Natural flavours can help manufacturers develop distinctive profiles in beverages, dairy products, confectionery, bakery products, sauces and savoury snacks. Citrus oils, vanilla extracts, fruit-derived ingredients and spice extracts offer a wide range of possibilities. However, natural origin alone does not guarantee better nutritional quality, safety or sustainability. Ingredient selection must consider the intended application, regulatory requirements, availability, cost and consistency.

Formulators also face technical challenges when replacing synthetic or nature-identical flavouring ingredients with natural alternatives. Natural compounds may be sensitive to heat, oxygen, light and changes in pH. Their flavour intensity can vary between harvests and suppliers, making standardisation difficult. Advanced extraction, stabilisation and encapsulation technologies are helping address these challenges, enabling manufacturers to retain desirable flavour characteristics throughout processing, storage and distribution.

Biotechnology and Fermentation Open New Possibilities

Biotechnology is expanding the range of ingredients available to flavour developers. Fermentation, enzyme technology and precision fermentation can support the production of selected flavour compounds, aroma molecules and functional ingredients under controlled conditions. These approaches may reduce dependence on certain agricultural raw materials and offer more consistent ingredient quality, depending on the process and production system.

Traditional fermentation also continues to influence food innovation. Products such as yoghurt, cheese, fermented vegetables, kombucha and other cultured foods demonstrate how microorganisms contribute to complex flavour profiles. During fermentation, microbial activity produces organic acids, esters, alcohols and other compounds that influence aroma, acidity, texture and overall sensory perception.

Food companies are applying this knowledge to develop new beverages, dairy alternatives, plant-based foods and savoury products. Fermentation can help reduce undesirable notes in some plant proteins while creating more rounded and familiar flavours. Nevertheless, outcomes depend on the microorganism, substrate, processing conditions and formulation. Manufacturers must carefully evaluate sensory performance, microbial safety, process reproducibility and regulatory compliance before scaling up new applications.

AI and Digital Tools Transform Flavour Development

Artificial intelligence and data analytics are beginning to change how food manufacturers identify flavour opportunities and develop new formulations. Traditional flavour development often involves repeated laboratory trials, sensory evaluations and adjustments by experienced food scientists. Although these methods remain essential, digital tools can help narrow the range of possible formulations and identify relationships that might otherwise take longer to discover.

Machine-learning systems can analyse ingredient characteristics, chemical composition, sensory descriptions and consumer feedback to suggest potential flavour combinations. When supported by reliable datasets, these tools may help developers screen ingredients, predict certain sensory outcomes and accelerate early-stage product development.

Digital platforms can also help manufacturers monitor emerging consumer preferences through product reviews, market research and other data sources. This can inform decisions about flavour extensions, seasonal launches and regional product variations.

Artificial intelligence and data analytics are beginning to change how food manufacturers identify flavour opportunities and develop new formulations. Traditional flavour development often involves repeated laboratory trials, sensory evaluations and adjustments by experienced food scientists. Although these methods remain essential, digital tools can help narrow the range of possible formulations and identify relationships that might otherwise take longer to discover.

However, AI cannot fully replace human sensory evaluation. Taste perception is influenced by aroma, texture, temperature, cultural familiarity and individual preferences. A combination that appears promising in a model may not perform well during actual consumption. The most effective approach integrates computational analysis with trained sensory panels, consumer testing and practical formulation expertise.

Reformulation: Delivering Taste with Less Sugar and Salt

Health-oriented reformulation is another important area of flavour innovation. Governments, public health organisations and consumers are encouraging the food industry to reduce excessive sugar and sodium in selected product categories. Yet removing these ingredients can affect much more than taste. Sugar contributes sweetness, bulk, texture and browning, while salt influences flavour perception and can affect product functionality and preservation.

Manufacturers are therefore exploring ways to maintain consumer acceptance while modifying formulations. Sweetness modulation, flavour masking, aroma enhancement, alternative sweetening systems and carefully balanced ingredient combinations can help reduce the sensory impact of reformulation. In savoury foods, herbs, spices, yeast extracts, vegetable concentrates and selected flavour compounds may contribute to a fuller taste experience when sodium levels are adjusted.

The objective is not simply to replace one ingredient with another. It is to create a balanced sensory profile that meets nutritional goals and performs consistently throughout the product's shelf life. Product developers must also evaluate labelling requirements, ingredient compatibility, consumer perception and the overall nutritional composition of the finished product.

Plant-Based Foods Need More Authentic Flavour Profiles

The development of plant-based foods has highlighted the importance of flavour engineering. Ingredients such as pea, soy, wheat and other plant proteins can have characteristic earthy, bitter, grassy or beany notes. These attributes may be acceptable in some applications but can limit consumer acceptance when the goal is to reproduce the taste of conventional meat or dairy products.

Flavour houses and food manufacturers are addressing these challenges through a combination of raw-material selection, fermentation, enzymatic treatment, masking agents, spices and reaction flavours. Fat systems, aroma release and processing conditions also influence the final sensory experience.

For plant-based meat alternatives, developers must reproduce several characteristics simultaneously, including roasted notes, savoury depth, juiciness and the aroma generated during cooking. In dairy alternatives, the challenge may involve balancing sweetness, acidity, creaminess and familiar dairy-associated aromas.

Future progress will depend on integrated formulation rather than flavour addition alone. Protein structure, moisture retention, fat distribution and thermal processing all contribute to the final eating experience. Products that combine convincing flavour with suitable texture, nutrition, affordability and convenient preparation are more likely to establish lasting consumer demand.

Global Inspiration Meets Regional Food Heritage

Global food culture is creating opportunities for manufacturers to introduce new flavour experiences across established product categories. Consumers can discover cuisines and ingredients through travel, restaurants, social media and online food content, encouraging interest in international and fusion-inspired products.

At the same time, regional food traditions remain a valuable source of innovation. India's diverse culinary heritage offers ingredients and flavour combinations that can be adapted for packaged snacks, ready-to-eat meals, sauces, beverages and convenience foods. Traditional chutney profiles, millet-based snacks, spiced dairy beverages and fruit-based preparations provide starting points for modern product development.

The opportunity lies in preserving the defining characteristics of traditional flavours while

adapting them to contemporary formats. Manufacturers must consider ingredient stability, manufacturing feasibility, consumer expectations and the risk of oversimplifying regional identities. Collaboration with culinary experts, local ingredient suppliers and sensory researchers can help ensure that innovation respects the character of the original food experience.

Flavour Stability, Processing and Packaging Considerations

A successful flavour profile must survive the manufacturing process and remain appealing until consumption. Heat treatment, drying, extrusion, freezing, oxygen exposure and prolonged storage can alter volatile compounds, reduce aroma intensity or create undesirable notes. These changes are particularly important in beverages, dairy products, bakery goods, snacks and ready meals.

Encapsulation can protect sensitive flavour compounds by surrounding them with suitable carrier materials, allowing controlled release during processing or consumption. Emulsification technologies can improve the dispersion of oil-soluble flavour ingredients in water-based systems, while suitable packaging can help limit exposure to oxygen, moisture and light. Manufacturers must evaluate flavour performance under actual production and storage conditions rather than relying solely on laboratory samples. Accelerated shelf-life studies, sensory testing and chemical analysis can help identify changes in aroma, taste and overall acceptability. Packaging selection, processing parameters and formulation design should therefore be considered together during product development.

Sustainability and Responsible Ingredient Sourcing

The future of flavour innovation will also depend on the sustainability and resilience of ingredient supply chains. Climate variability, crop disease, water stress and changing agricultural conditions can affect the availability, quality and price of spices, herbs, vanilla, citrus and other flavour ingredients. Manufacturers are exploring alternative sourcing regions, improved agricultural practices, traceability systems and the use of underutilised crops. Upcycling selected food-processing by-products may also provide opportunities to recover useful aromatic compounds or develop ingredients for appropriate applications. Such approaches require careful assessment of food safety, extraction efficiency, sensory quality and commercial feasibility.

Sustainability claims must be supported by evidence. A natural ingredient is not automatically more environmentally friendly than a synthetic alternative, as land use, water consumption, transport, extraction and processing requirements can vary considerably. Life-cycle assessment and responsible sourcing practices can help companies evaluate environmental impacts more objectively.

The Road Ahead: Building the Next Generation of Flavours

Flavour innovation is likely to become increasingly interdisciplinary, bringing together food science, biotechnology, digital analytics, sensory research, nutrition and sustainable sourcing. Advances in ingredient processing and formulation will create opportunities to develop more complex sensory profiles, improve consistency and respond to specialised consumer requirements.

For manufacturers, the priority will be to translate these technological possibilities into products that people genuinely enjoy. Novelty may generate initial interest, but repeat purchases depend on reliable taste, value, convenience and quality. Regulatory compliance, transparent labelling and responsible communication will remain equally important as new flavour ingredients and production methods enter the market.

The future of food will not be defined by technology alone. It will be shaped by how effectively manufacturers combine scientific innovation with culinary understanding and consumer insight. By treating flavour as a core component of product strategy, the food and beverage industry can create products that meet changing expectations while preserving the sensory pleasure that makes food meaningful.

Conclusion

Flavour is emerging as a powerful link between consumer experience, product innovation and manufacturing technology. Natural ingredients, fermentation, AI-assisted formulation, healthier reformulation, plant-based product development and sustainable sourcing are expanding the possibilities available to food manufacturers. At the same time, challenges involving ingredient variability, flavour stability, cost and consumer acceptance remain significant. Companies that invest in research, sensory evaluation and collaborative product development will be better positioned to respond to these challenges. Ultimately, the future of flavour innovation lies in achieving the right balance between creativity and consistency, scientific progress and culinary heritage, and consumer enjoyment and responsible food production.

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Fruit Puree: A Multifunctional Ingredient Driving Innovation in Food Formulation

Mrs. Preeti Kohli



As food manufacturers respond to growing demand for natural, nutritious and clean-label products, fruit puree is gaining importance as a versatile ingredient across the food and beverage industry. Traditionally used to impart fruit flavour and sweetness, purees are now valued for their broader functional properties, including texture enhancement, moisture retention, natural colouring, viscosity development and partial replacement of conventional ingredients. Their ability to combine several formulation benefits in a single ingredient makes them particularly attractive for manufacturers seeking to simplify ingredient lists and develop innovative products.

Derived from the edible pulp of fruits, purees provide a concentrated combination of natural sugars, dietary fibre, organic acids, vitamins, minerals and bioactive compounds. Depending on the fruit variety and processing conditions, they can contribute different sensory and technological characteristics. From beverages and dairy products to bakery, confectionery, sauces and plant-based alternatives, fruit purees are becoming an important formulation tool for developing products that balance taste, functionality and nutritional appeal.

Understanding Fruit Puree as a Food Ingredient

Fruit puree is produced by mechanically pulping or blending edible fruit portions into a semi-solid preparation. Unlike clarified fruit juice, which contains relatively little suspended pulp, puree retains a significant proportion of the fruit's natural solid components, including varying amounts of fibre and pectin. This gives it functional properties that extend beyond flavour delivery.

Different fruits offer distinct ingredient characteristics. Apple puree is valued for its pectin content, mild flavour and ability to contribute body and consistency. Banana puree provides natural sweetness, creamy texture and viscosity, making it suitable for bakery and dairy formulations. Mango puree contributes colour, sweetness and a rich mouthfeel, while berry purees offer natural pigments such as anthocyanins and characteristic antioxidant compounds. Citrus and passion fruit purees contribute acidity and intense flavour, helping balance sweetness in beverages, desserts and confectionery.

For food formulators, selecting the right puree involves evaluating parameters such as soluble solids content, pH, titratable acidity, viscosity, colour, particle size and flavour intensity. These characteristics determine how the ingredient will interact with other components and perform during processing and storage.

Functional Properties That Make Fruit Puree Valuable

One of the major advantages of fruit puree is its multifunctionality. It can perform several roles within a food formulation, reducing the need for multiple conventional ingredients in certain applications.

Natural Sweetening and Flavour Enhancement: Fruit purees contain naturally occurring sugars, primarily glucose, fructose and sucrose, which contribute sweetness and flavour. They can partially replace refined sugar in selected formulations while adding fruit character. Apple, banana, mango and date-based preparations are particularly useful in products where natural sweetness is desired. However, replacing refined sugar with puree requires careful formulation because fruit sugars still contribute to total sugar content and do not provide identical sweetness, bulk or preservation properties.

Texture Development and Viscosity Control: Pectin, fibre and suspended fruit particles contribute to the consistency and mouthfeel of purees. Apple puree, for example, can provide body and help improve the structure of fruit preparations, while banana puree adds thickness and creaminess. These properties are useful in yogurt, dessert fillings, sauces, smoothies and bakery products. The functional performance depends on fruit composition, processing conditions, pH and interactions with other formulation ingredients.

Moisture Retention and Fat Replacement: Fruit purees are increasingly used to partially replace fats in bakery formulations. Apple and banana purees can contribute moisture and softness to cakes, muffins, cookies and quick breads. Their water-binding properties can help improve product tenderness and reduce the requirement for certain fat ingredients. However, they do not replicate all the structural and aeration functions of fats, so recipe adjustments are necessary to maintain volume, texture and shelf stability.

Natural Colour and Bioactive Compounds: Fruit purees offer naturally occurring pigments that can improve the visual appeal of food products. Carotenoids in mango and papaya contribute yellow-orange shades, while anthocyanins in strawberries, blueberries and raspberries provide red, purple and blue hues. These compounds are also associated with antioxidant activity. Their stability, however, depends on factors such as heat, light, oxygen exposure and product acidity.

Nutritional Enhancement: Depending on the fruit and processing method, purees contribute dietary fibre, vitamin C, potassium, folate and various phytochemicals. Berry purees provide polyphenols, while apple and pear purees contribute pectin and other soluble fibre. Although processing may reduce certain heat-sensitive nutrients, purees can still serve as valuable fruit-based components in nutritional product development.

Applications Across Food and Beverage Categories

Beverages and Smoothies: Fruit purees are widely used in smoothies, nectars, milkshakes, fruit drinks and ready-to-drink beverages. They provide flavour, colour, pulp content and mouthfeel, helping manufacturers develop products with a more substantial fruit character. Mango, guava, pineapple, passion fruit and mixed-berry purees are popular choices. Their natural acidity and sweetness also help balance beverage formulations,

although stabilisers may be required to prevent sedimentation or phase separation.

Dairy and Plant-Based Products: Yogurt, flavoured milk, ice cream, frozen desserts and drinking yogurt use fruit purees as flavouring and texturising ingredients. They can be incorporated as fruit preparations, layered fillings or swirls. In plant-based products made from oat, almond, soy and coconut, fruit purees provide flavour, colour and body while supporting product differentiation. Pectin-rich fruit preparations can also help improve consistency in suitable formulations.



Bakery and Cereal Products: Fruit purees are used in cakes, muffins, breads, pancakes, pastries and breakfast products. Banana and apple purees can partially replace fats or added sugars, while also improving moisture retention. Fruit purees are also used in bakery fillings, toppings and glazes. In cereal bars and granola-based snacks, they act as binding ingredients, helping hold together grains, nuts and seeds.

Confectionery and Fruit-Based Snacks: Fruit purees are important ingredients in fruit jellies, gummies, fruit leathers, snack bars and soft confectionery. Their natural sugars, acids, pectin and flavour compounds contribute to taste and texture. In fruit-based gummies, pectin-rich purees can support gel formation when combined with appropriate sugar, acid and processing conditions. Manufacturers are also exploring puree blends to create distinctive flavour profiles and products with fruit-derived ingredients.

Sauces, Dressings and Condiments: Apple, mango, apricot, tamarind and berry purees are increasingly incorporated into barbecue sauces, chutneys, marinades, salad dressings and sweet-and-sour condiments. They contribute natural sweetness, acidity, viscosity and colour, making them useful for balancing complex savoury flavour profiles. Their ability to provide both liquid and solid components also supports the development of smooth, consistent sauces.

Baby Food and Specialised Nutrition: Fruit purees are widely used in complementary foods for infants and young children because of their smooth consistency and fruit-derived nutrients. Apple, banana, pear, peach and mango are common choices. Manufacturers must ensure stringent controls over microbiological safety, contaminants, nutritional composition and texture, particularly for products intended for sensitive consumer groups.

Processing and Ingredient Quality: The Science Behind Performance

The functional properties of fruit puree depend significantly on the way it is processed. Commercial production generally involves fruit selection, washing, sorting, peeling, deseeding, pulping, refining and homogenisation. Depending on the fruit and intended application, the puree may undergo enzyme inactivation, concentration and preservation treatments.

One important consideration is pectin structure. Pectin is a naturally occurring polysaccharide found in fruit cell walls and plays an important role in viscosity and gel formation. Processing conditions can influence its molecular structure and functional behaviour, affecting the final product's consistency and stability. This is particularly relevant in jams, fruit fillings, dairy preparations and confectionery.

Preservation technology also influences ingredient quality. Conventional pasteurisation helps control microorganisms and inactivate spoilage enzymes, but excessive heat can affect colour, flavour and heat-sensitive nutrients. High-Pressure Processing (HPP) offers an alternative for suitable fruit purees by reducing microbial populations while generally retaining more fresh-like sensory characteristics. Aseptic processing and packaging provide another solution, enabling commercially sterile purees to be stored at ambient temperatures in suitable sealed packaging.

Research into non-thermal technologies such as pulsed electric fields and ultrasound is also exploring ways to improve microbial control, extraction efficiency and retention of bioactive compounds. Their commercial application depends on the composition and viscosity of the puree, process validation and equipment economics. For ingredient suppliers, standardisation is equally important. Manufacturers require consistent specifications for °Brix, acidity, viscosity, colour and microbial quality to ensure predictable performance across production batches.

Emerging Ingredient Innovations and Sustainability

The development of customised fruit puree blends is creating new opportunities in food formulation. Combining fruits with different functional properties can help achieve specific sweetness, acidity, colour and texture profiles. For example, apple puree may provide body, while passion fruit contributes acidity and mango adds sweetness and colour. There is also growing interest in organic purees, exotic fruit ingredients, concentrated purees and formulations designed for reduced-added-sugar products. Fruit purees are finding opportunities in plant-based desserts, functional beverages and convenient nutritional snacks.

Sustainability is another important consideration. Fruits that do not meet fresh retail appearance standards can be processed into purees if they meet food safety and quality requirements. Furthermore, fruit peels, seeds and pomace can be explored as sources of pectin, dietary fibre, natural pigments and polyphenols. Recovering these compounds supports better utilisation of agricultural resources and reduces processing waste.

Future Outlook

According to Research and Market - The Fruit Puree Market is projected to reach USD 5.78 Billion in 2026. It is expected to continue growing at a CAGR of 6.46%, reaching USD 8.45 Billion by 2032.

As food manufacturers increasingly seek ingredients that deliver multiple formulation benefits, fruit puree is moving beyond its conventional role as a flavouring component. Its contribution to sweetness, texture, colour, moisture retention and nutritional composition makes it a valuable ingredient across several food categories. Advances in processing, preservation and ingredient standardisation will further improve its functionality and commercial versatility. With opportunities spanning clean-label beverages, dairy alternatives, bakery, confectionery and plant-based foods, fruit puree is well positioned to support the development of next-generation food products. Its combination of natural origin, functional versatility and formulation flexibility makes it an increasingly important ingredient in the evolving food industry.

The Roadmap of Global Food Cold Chain Logistics in 2027: Building Smarter, Greener and More Resilient Supply Chains

Ritesh Verma



The global food cold chain is entering a new phase of transformation, driven by rising demand for perishable foods, digital technologies, energy-efficient refrigeration and stricter food safety expectations. In 2027, the industry will increasingly focus on creating connected, sustainable and resilient temperature-controlled supply chains, from farm-level pre-cooling to international transportation and last-mile delivery.

The global food industry is undergoing a significant transformation as consumers increasingly demand fresh, frozen, minimally processed and ready-to-eat products. Expanding international food trade, changing consumption patterns, urbanisation and the growth of organised retail are creating new requirements for the transportation and storage of temperature-sensitive products. In this changing environment, cold chain logistics is becoming an essential component of the global food supply system.

Maintaining product quality and safety throughout transportation, storage and distribution requires more than refrigerated warehouses and vehicles. It demands an integrated infrastructure that connects farmers, food processors, packaging companies, logistics providers, distributors, retailers and consumers through reliable temperature management and information exchange. As the industry moves towards 2027, the priorities of cold chain operators are expanding beyond capacity development. Companies are increasingly looking at operational efficiency, automation, real-time shipment visibility, alternative refrigeration technologies and lower-carbon transportation. The objective is to create supply chains capable of protecting food quality while managing energy consumption, reducing product losses and responding to disruptions.

According to Mordor Intelligence, the global cold chain logistics market is estimated at US$384.9 billion in 2026 and is projected to reach US$408.4 billion in 2027, with further growth expected in the following years. Asia-Pacific is identified as the largest and fastest-growing regional market in its forecast. These projections reflect the increasing importance of temperature-controlled infrastructure across food, pharmaceutical and other temperature-sensitive industries.

For 2027, the industry's roadmap will be shaped by several interconnected developments, including infrastructure expansion, intelligent logistics, sustainable refrigeration, improved packaging and stronger international supply chain coordination.

1. Expanding Cold Chain Infrastructure from Farm to Consumer

One of the most important priorities for 2027 will be strengthening cold chain infrastructure across the entire food supply network. While developed markets have established temperature-controlled warehouses, refrigerated transportation networks and organised distribution systems, several emerging economies continue to face gaps in post-harvest cooling, rural storage and refrigerated connectivity.
These infrastructure limitations have significant consequences for food quality, availability and profitability. Fresh fruits, vegetables, dairy products, meat, seafood and other perishables can deteriorate rapidly when exposed to unsuitable temperatures during harvesting, handling or transportation.

The Food and Agriculture Organization (FAO) highlighted in March 2026 that approximately 526 million tonnes of food, representing around 12% of the global total, are lost or wasted due to insufficient refrigeration. The organisation emphasised the importance of pre-cooling, cold storage, temperature monitoring and reliable downstream distribution in reducing food losses.

In 2027, investment is expected to focus increasingly on decentralised and strategically located cold chain facilities. Rather than relying exclusively on large distribution centres near major cities, operators will need to develop smaller cold storage units closer to agricultural production areas, fishing centres and food processing clusters.

Pre-cooling facilities will play a particularly important role in preserving the quality of fresh produce immediately after harvesting. Rapid cooling can slow respiration, reduce moisture loss and delay deterioration, helping agricultural products maintain their quality during subsequent transportation. The development of packhouses, refrigerated collection centres, blast freezing facilities, ripening chambers and multi-temperature warehouses will also become increasingly important. For emerging markets, particularly across Asia, Africa and Latin America, the next stage of cold chain development will require investment in infrastructure that connects rural production areas with domestic consumption centres and international export markets.

2. Digitalisation and Real-Time Temperature Monitoring

Digital transformation will be among the defining characteristics of global cold chain logistics in 2027. Food manufacturers and logistics operators are increasingly recognising that maintaining the required temperature is only one part of the process. They also need reliable information about product conditions, shipment location, transportation delays and equipment performance.

Internet of Things (IoT) sensors, cloud-based monitoring platforms, GPS tracking and wireless data loggers are becoming essential tools for improving shipment visibility.

These technologies allow operators to monitor

temperature, humidity, location and other relevant parameters throughout transportation and storage. When conditions move outside predefined limits, automated alerts can notify logistics managers, enabling corrective action before product quality is significantly affected. For example, a refrigerated truck transporting dairy products can be monitored continuously to identify refrigeration failures, unexpected temperature fluctuations or delays. Similarly, temperature sensors installed inside cold storage facilities can help operators identify equipment inefficiencies and maintain consistent storage conditions.

In 2027, the industry is expected to move towards more integrated monitoring systems that connect warehouses, transportation fleets, ports and distribution centres through centralised digital platforms. The growing use of artificial intelligence (AI) will further strengthen these capabilities. AI-powered systems can analyse historical shipment information, weather conditions, traffic patterns, refrigeration performance and delivery schedules to improve operational planning.

Predictive analytics will also help operators anticipate equipment failures, identify potential temperature excursions and schedule preventive maintenance. Digital twins, which create virtual representations of physical logistics operations, offer another opportunity. By simulating warehouse conditions, transportation routes and inventory movements, operators can evaluate different operating scenarios before implementing changes.

A 2026 review published in Trends in Food Science & Technology identifies digital twins, multimodal data integration and intelligent optimisation as important future directions for sustainable food cold chain logistics.
The larger objective for 2027 will be to move from reactive temperature monitoring towards predictive and data-driven supply chain management.

3. Sustainable Refrigeration and Energy-Efficient Operations

Sustainability will remain a central consideration in the development of cold chain infrastructure. Refrigeration is essential for preserving food, but cold storage facilities, refrigerated trucks, containers and processing units require substantial amounts of energy.
Rising electricity prices, fuel costs and environmental regulations are encouraging operators to reconsider the technologies used across their refrigeration networks. In 2027, energy-efficient refrigeration systems will increasingly become an investment priority. High-efficiency compressors, advanced heat exchangers, variable-speed drives, improved insulation and intelligent defrosting systems can help reduce energy consumption without compromising temperature performance.
The transition towards lower-global-warming-potential (GWP) refrigerants will also influence refrigeration equipment selection and infrastructure upgrades.

Natural refrigerants such as ammonia, carbon dioxide and hydrocarbons are receiving increasing attention because of their environmental characteristics. However, their adoption requires appropriate engineering, safety systems, technical expertise and compliance with applicable regulations. Another important development will be the integration of renewable energy into cold storage facilities. Solar photovoltaic installations, battery energy storage and hybrid power systems can reduce dependence on conventional electricity sources, particularly in locations with unreliable grid infrastructure.

Natural refrigerants such as ammonia, carbon dioxide and hydrocarbons are receiving increasing attention because of their environmental characteristics. However, their adoption requires appropriate engineering, safety systems, technical expertise and compliance with applicable regulations. Another important development will be the integration of renewable energy into cold storage facilities. Solar photovoltaic installations, battery energy storage and hybrid power systems can reduce dependence on conventional electricity sources, particularly in locations with unreliable grid infrastructure.

FAO has highlighted decentralised solar-powered refrigeration as a practical approach for supporting cold storage, pre-cooling and ice production in remote agricultural areas. Such systems can improve access to refrigeration while reducing dependence on fossil-fuel-based energy. Cold storage operators will also increasingly evaluate their energy performance through monitoring and benchmarking. Measuring electricity consumption per pallet, tonne of product or unit of throughput can help identify inefficiencies and establish measurable improvement targets.

For the global industry, sustainability in 2027 will therefore involve more than installing environmentally friendly refrigeration equipment. It will require a coordinated approach to energy management, equipment maintenance, facility design and logistics planning.

4. Electrification and Modernisation of Refrigerated Transportation

Transportation remains one of the most critical and challenging components of food cold chain logistics. Products frequently travel across long distances, multiple distribution centres and different modes of transportation before reaching consumers.

Refrigerated trucks, trailers, containers and rail systems must maintain consistent conditions despite changing external temperatures, traffic congestion and operational delays.
In 2027, transportation operators will increasingly focus on improving fleet efficiency through vehicle electrification, advanced refrigeration systems and route optimisation.
Electric refrigerated vehicles are expected to gain attention, particularly for urban distribution and short-distance transportation. Their adoption can help reduce tailpipe emissions and noise while supporting sustainability targets. However, the wider deployment of electric refrigerated fleets will depend on vehicle availability, battery performance, charging infrastructure, payload requirements and the additional energy needed to operate refrigeration units.

For longer-distance transportation, hybrid refrigeration systems and more efficient diesel-powered alternatives are likely to remain important during the transition. Refrigerated containers, commonly known as reefer containers, will continue to support international food trade. Their role is particularly important for transporting frozen seafood, meat, dairy products and fresh produce across continents.
DHL Global Forwarding's Q4 2026 ocean reefer market update forecasts global containerised reefer volumes to grow by 2.4% year-on-year in 2026, exceeding 132 million tonnes. It also identifies port congestion, longer vessel rotations, equipment imbalances and geopolitical disruptions as continuing challenges for refrigerated cargo movement.

For 2027, these developments highlight the importance of improving reefer equipment availability, maintaining reliable port connections and strengthening coordination between shipping companies, freight forwarders and cargo owners. Route optimisation will also become increasingly important. AI-powered transportation management systems can identify efficient routes, reduce unnecessary kilometres, coordinate delivery schedules and improve vehicle utilisation. The industry will need to balance transportation speed, energy efficiency, product quality and operating costs while building more reliable refrigerated distribution networks.

5. Advanced Packaging and Temperature-Controlled Product Protection

Packaging will become an increasingly important part of the cold chain strategy in 2027. Although refrigeration controls the surrounding environment, packaging protects products against temperature fluctuations, physical damage, moisture loss and contamination



during handling and transportation. Developments in insulated packaging, thermal liners, phase-change materials (PCMs), modified atmosphere packaging and intelligent packaging are creating new opportunities for improving product protection.

Phase-change materials can absorb or release thermal energy during changes in temperature, helping maintain a more stable environment within insulated containers. These materials are particularly relevant for transporting temperature-sensitive products across distribution networks where continuous refrigeration may not always be available.

Modified atmosphere packaging, meanwhile, helps extend the shelf life of selected food products by controlling the composition of gases inside packaging. Smart packaging technologies are also gaining importance. Temperature-sensitive labels, time-temperature indicators and connected monitoring devices can provide information about the product's exposure to unsuitable conditions.
For food exporters and retailers, these solutions can support better quality management and reduce uncertainty during transportation.
Another priority will be reducing the environmental impact of packaging materials. Manufacturers are exploring recyclable, reusable and lightweight packaging solutions that offer adequate thermal protection while minimising material consumption.

In 2027, the relationship between packaging manufacturers and cold chain operators will become increasingly important. Packaging solutions will need to be designed according to the transportation distance, storage requirements, product characteristics and expected handling conditions.

6. Warehouse Automation and Intelligent Inventory Management

The growth of frozen food, dairy, seafood, meat and ready-to-eat product categories is increasing the operational requirements of temperature-controlled warehouses. Managing large volumes of inventory in low-temperature environments presents challenges related to labour availability, product handling, storage utilisation and energy consumption.

Warehouse automation will therefore be an important part of the 2027 cold chain roadmap.

Automated storage and retrieval systems (AS/RS), automated guided vehicles (AGVs), autonomous mobile robots (AMRs), conveyor systems and robotic palletising solutions can improve material handling while reducing repetitive manual operations. High-density storage systems can also improve space utilisation, allowing operators to handle larger product volumes within existing facilities. Automation offers additional advantages in frozen warehouses, where prolonged exposure to extremely low temperatures can create difficult working conditions for employees.
Alongside physical automation, warehouse management systems (WMS) will play a greater role in coordinating inventory movements and maintaining product traceability.
Advanced software can monitor stock levels, expiry dates, batch numbers, storage locations and dispatch schedules. This supports the implementation of first-expired, first-out (FEFO) inventory management, which is particularly relevant for perishable food products. AI-based demand forecasting can further help operators align inventory levels with expected customer requirements. Better forecasting can reduce overstocking, unnecessary storage time and product wastage.

The objective will be to create intelligent warehouses that combine automated material handling, energy-efficient refrigeration and real-time inventory visibility.

7. Strengthening Food Safety, Traceability and Regulatory Compliance

Food safety will remain a fundamental requirement for global cold chain operations in 2027. Temperature fluctuations, inadequate handling, contamination and insufficient documentation can compromise product quality and create significant financial and reputational risks. As international food trade expands, manufacturers and logistics providers must demonstrate greater control over product conditions throughout the supply chain. Digital traceability systems will become increasingly important in achieving this objective. By recording product origin, batch information, processing details, storage conditions and transportation history, these systems can provide a more complete record of food movement.

Blockchain-based platforms may support secure information sharing between different supply chain participants, although their effectiveness depends on data accuracy, system interoperability and stakeholder participation.
Temperature monitoring will also become more closely integrated with quality assurance systems. Instead of simply recording whether a shipment remained within the prescribed temperature range, operators will increasingly assess the duration and severity of temperature deviations and their potential impact on product quality. This will support more informed decisions regarding product acceptance, additional testing, shipment release and corrective action.

In 2027, companies will need to ensure that their cold chain operations comply with applicable national and international food safety requirements, including relevant HACCP-based procedures and temperature management standards. Greater collaboration between food manufacturers, logistics companies, regulatory authorities and retailers will be essential to establishing consistent safety practices.

8. Regional Development: Asia-Pacific Emerges as a Major Growth Engine

Although cold chain development is a global priority, regional investment patterns will differ according to infrastructure maturity, consumption trends, food production and international trade requirements.

Asia-Pacific: The region is expected to remain a major growth engine for cold chain logistics, supported by expanding urban populations, rising consumption of packaged and frozen foods, organised retail and international food trade. China, India, Japan, South Korea and Southeast Asian markets will continue to offer opportunities for refrigerated storage, trans-

portation and digital monitoring solutions. India, in particular, has considerable potential for cold chain infrastructure development across dairy, seafood, meat, fruits and vegetables. Investment in farm-level pre-cooling, packhouses, reefer transportation and integrated distribution networks will be important for connecting agricultural producers with domestic and export markets.

North America: The region's established cold storage networks will increasingly focus on automation, energy efficiency, warehouse modernisation and supply chain resilience. Retail distribution, frozen food consumption and advanced inventory management will remain important demand drivers.

Europe: Sustainability regulations, energy efficiency requirements and the transition towards lower-emission refrigeration technologies will influence investment decisions. Operators will increasingly focus on refrigeration upgrades, renewable energy integration and environmentally responsible transportation.

Latin America: The region's strong agricultural and food export sectors create opportunities for cold chain expansion, particularly for fruits, vegetables, seafood and meat. Improved port infrastructure, refrigerated transportation and temperature-controlled export facilities will be important for strengthening international market access.

Middle East and Africa: Rising food import requirements, urbanisation and the need to improve food security will support investment in refrigerated warehouses, distribution centres and modern food logistics infrastructure. Solar-powered refrigeration and decentralised cold storage will offer opportunities in locations with limited electricity access.

9. Building Resilience Against Global Supply Chain Disruptions

Global food cold chains operate within a complex international environment influenced by geopolitical developments, extreme weather, fuel price fluctuations, port congestion and changing trade policies. Unlike conventional cargo, temperature-sensitive food products have limited tolerance for transportation delays and refrigeration failures. A disruption at one stage can affect product quality throughout the remaining distribution process.

Building resilience will therefore become a strategic priority in 2027.

Companies will increasingly evaluate alternative transportation routes, diversify logistics partners and develop contingency plans for critical supply chain operations.

For 2027, the industry's roadmap can be understood through five major priorities:

Strategic priority	Key industry actions
Infrastructure development	Expand pre-cooling, cold storage, reefer transportation and regional distribution facilities.
Digital integration	Deploy IoT sensors, real-time monitoring, AI-based forecasting and integrated logistics platforms.
Sustainability	Adopt energy-efficient refrigeration, lower-GWP refrigerants and renewable energy solutions.
Operational excellence	Introduce warehouse automation, intelligent routing and advanced inventory management.
Supply chain resilience	Strengthen traceability, contingency planning, supplier coordination and transportation flexibility.

Multi-location cold storage networks can help reduce dependence on individual facilities, while strategic inventory planning can provide additional flexibility during transportation disruptions. Real-time shipment visibility will also support faster decision-making when delays occur. Logistics teams can identify affected consignments, assess remaining product shelf life and coordinate alternative delivery arrangements. Collaboration will be equally important. Food producers, shipping companies, freight forwarders, warehouse operators and retailers will need to exchange information and coordinate their responses to unexpected disruptions. The focus will shift towards building supply chains that can continue operating under difficult conditions rather than relying exclusively on cost-efficient, tightly optimised networks.

10. The Roadmap for 2027: Priorities for Industry Stakeholders

The transition towards smarter and more sustainable cold chain logistics will require coordinated action across technology, infrastructure, operations and workforce development. Achieving these priorities will also require investment in skilled personnel. Refrigeration engineers, warehouse automation specialists, fleet managers, data analysts and food safety professionals will play an increasingly important role in managing modern cold chain operations. Industry associations, governments and technology providers will need to support training programmes, infrastructure development and the adoption of suitable standards.

For small and medium-sized food businesses, access to affordable cold storage and shared logistics infrastructure will be particularly important. Collaborative cold chain facilities and third-party logistics services can help smaller producers access temperature-controlled distribution without making substantial individual capital investments.

Conclusion: From Temperature Control to Intelligent Food Logistics

The global food cold chain industry is approaching an important turning point. In 2027, the focus will increasingly move beyond maintaining refrigerated conditions towards building integrated logistics systems that combine technology, sustainability, operational efficiency and supply chain resilience.

Infrastructure expansion will remain essential, particularly in emerging markets where gaps in rural refrigeration and transportation continue to contribute to food losses. At the same time, digital monitoring, artificial intelligence, warehouse automation and advanced packaging will redefine how temperature-sensitive products are stored, transported and distributed.

Sustainability will be another defining factor. Energy-efficient refrigeration, renewable power, improved insulation, lower-impact refrigerants and optimised transportation will become increasingly important as companies seek to reduce their environmental footprint while managing operating costs. However, technology alone will not determine the success of the industry's transformation. Reliable infrastructure, skilled personnel, regulatory coordination and collaboration among supply chain participants will be equally important.

Ultimately, the roadmap for 2027 is about creating a connected food logistics ecosystem in which every stage, from harvesting and processing to storage, transportation and retail, operates with greater visibility and control.

For food manufacturers, cold chain operators, equipment suppliers and technology providers, the opportunity lies in developing solutions that not only preserve food quality but also reduce losses, improve efficiency and strengthen global food distribution. The companies that successfully combine these capabilities will be better positioned to meet the evolving demands of the global food industry.

sources to the article are available upon reader request

Dp World launches First FMCG Contract Logistics Hub in Italy



DP World has launched its first Fast Moving Consumer Goods (FMCG) Contract Logistics operation in Italy, opening a 22,000 m^2 temperature-controlled, multi-customer facility near Bologna designed to serve customers across the food and beverage industry, as well as e-commerce and consumer goods sectors.

The move builds on DP World's existing logistics presence in one of Europe's largest consumer and manufacturing markets and strengthens its Contract Logistics capabilities in the food and beverage sector. From Castel San Pietro Terme, near Bologna, DP World will combine warehousing, transport, e-commerce fulfilment and value-added logistics services to provide integrated, end-to-end supply chain solutions for customers in Italy and across Europe. The operation was established through a strategic partnership with Alce Nero, an Italian organic food company and the site's anchor customer. Under the partnership, DP World manages key elements of Alce Nero's logistics operations, including warehousing, e-commerce fulfilment and transportation, allowing the company to focus its resources on growing its core business and future growth.

Rainer Schmid, CCO, DP World Europe, said: "Launching our first FMCG Contract Logistics operation in Italy is an important milestone for DP World. Italy is a key European market, and expanding our capabilities here strengthens our network while opening new opportunities in the food and beverage sector.

"Our partnership with Alce Nero is a strong example of how we want to grow: by starting with a customer need, building the right solution around it and creating capabilities that can then support other businesses in the market." The operation includes temperature-controlled storage at 18–20°C, organic product handling capabilities and integrated logistics technology. These capabilities enable the operation to support a range consumables businesses, including premium and organic brands, alongside customers in e-commerce, consumer goods and technology. The 22,000 m^2 multi-customer operation has approximately 30,000 pallet positions and capacity to support additional customers. Its location near Bologna provides access to Italy's domestic market and major European transport corridors, creating a platform for DP World to expand its Contract Logistics offering as customer demand grows.

Renzo Patelli, General Manager, Alce Nero Spa, said: "We are very pleased with the launch of our partnership with DP World. Finding the right logistics partner was an important process for Alce Nero, given the complexity of our business model, which brings together different supply chains, members, partners and customers across multiple channels, each with specific requirements and logistics flows.

"This partnership gives us a more integrated approach to managing that complexity and will help make our logistics operations more efficient, flexible and responsive as we pursue further growth in Italy and internationally. It will also allow us to focus even more closely on our core business: producing and bringing to market high-quality organic food that reflects the values that have always guided Alce Nero."

The expansion builds on DP World's existing logistics presence in Italy and strengthens its wider European network, supporting the company's strategy to provide customers with increasingly integrated, end-to-end supply chain solutions.

Mobergs becomes Sesotec: Unified brand presence strengthens position in Nordics and Baltics



Mobergs Produktkontroll AB, which joined the Sesotec Group in 2024, will officially change its name to Sesotec AB on 2 November 2026. The transition marks the completion of a gradual integration following more than 35 years of collaboration between the two companies. While the company will adopt the Sesotec brand and unified corporate identity, its existing customer contacts, regional expertise and local service will remain unchanged.

The integration will give customers and partners in the Nordic and Baltic markets more direct access to Sesotec's international portfolio of solutions for foreign object detection, material sorting and analysis, along with its technical development and service capabilities. The company said the move will combine Mobergs' established market knowledge and customer relationships with the wider resources and technologies of the Sesotec Group. Joachim Schulz, CEO of Sesotec, said the transition reflects the companies' existing operational integration and their shared commitment to customer support.

Fredrik Moberg, Managing Director of Sesotec AB, described the common branding as a natural next step in the long-standing partnership, highlighting the companies' shared focus on reliable technology, quality and customer service. The name change will take effect on 2 November, while the transition of visual identity, communication materials, digital platforms and other channels will be implemented gradually. The unified brand is intended to strengthen Sesotec's presence and long-term support for customers across Scandinavia and the Baltic countries.

DKSH Expands Partnership with GNT for Natural Colors in Vietnam's Food and Beverage Industry



DKSH's Business Unit Performance Materials, a leading distributor of specialty chemicals and ingredients, has expanded its collaboration with GNT International B.V. ("GNT"), a global leader in plant-based coloring foods, bringing their Exberry natural color portfolio to customers in Vietnam. Exberry is a registered trademark of GNT. Under the agreement, DKSH will provide business development, market analysis, marketing and sales, distribution and logistics, regulatory support, and technical services to accelerate the growth of GNT's natural color solutions in the Vietnamese food and beverage market.

The expanded collaboration builds on a longstanding relationship between DKSH and GNT in other markets, including Australia, New Zealand, and Japan. Leveraging DKSH's extensive regional presence, deep industry expertise, strong customer network, and regulatory capabilities, GNT aims to strengthen its reach among food and beverage manufacturers in Vietnam and unlock new growth opportunities.

GNT is a leading provider of plant-based coloring ingredients marketed under its globally recognized Exberry brand. The company provides natural color solutions derived from non-GMO fruits, vegetables, and edible plants, enabling food and beverage manufacturers to create visually appealing products while meeting increasing consumer demand for clean-label, naturally sourced ingredients.

GNT's natural color portfolio is suitable for applications in beverages, bakery, confectionery, dairy, cereals, snacks, sauces, savory, plant-based meat, seafood, and dairy, and helps manufacturers develop products that align with evolving market trends toward transparency, sustainability, and natural ingredients. The solutions are used across multiple categories, providing versatility, stability, ease-of-use, and strong sustainability credentials, allowing brands to achieve vibrant colors while maintaining a natural positioning.

Andreas Thiede, General Manager at GNT Singapore Pte. Ltd., commented: "Exberry colors allow manufacturers to deliver the natural and eye-catching products consumers want to see. DKSH is perfectly placed to help us meet the growing demand for natural ingredients in Vietnam thanks to its strong market presence and consistent track record. Together, we can deliver enhanced value for food and beverage brands throughout the country."

Cesar Saez, Vice President, Business Unit Performance Materials, Southeast Asia, DKSH, added: "We are delighted to further strengthen our partnership with GNT and support the growth of its Exberry natural color solutions in Vietnam. As consumer demand for natural and clean-label products continues to increase, DKSH's local market knowledge, regulatory expertise, sales excellence, innovation and formulation capabilities, and collaborative mindset will help bring innovative coloring solutions to food and beverage manufacturers across the market."



AAK, Bühler, Givaudan and Ingredion announce Top 5 companies selected for the Healthy Snacks Challenge 2027



AAK, Bühler, Givaudan and Ingredion have selected five start-ups and SMEs to participate in the Healthy Snacks Challenge 2027, a collaborative innovation programme aimed at accelerating the development of healthier, appealing and commercially viable snack solutions for consumers across Asia Pacific. The selected companies are Anomaly Bio (Singapore), Agro Ludens (Japan), Coa & Co (Singapore), Protoga (China) and ROA Midnight Pte Ltd (Singapore). Their innovations include fermentation-based protein and fibre ingredients, rice-derived mycoprotein, protein-rich chocolate clusters, microalgae-based proteins and cleaner-label, high-fibre snack products.

Between October and December 2026, the selected companies will participate in concept validation and technical discussions with experts from the four programme partners. They will then attend Snacks Hack Week in Singapore from January 18–22, 2027, where they will work with technical, product and innovation specialists on ingredient exploration, formulation development, sensory evaluation, processing and prototype refinement. The programme will conclude with a Finalists Demo Day on January 22, where participants will present their innovations and offer product tastings to industry representatives, customers and other stakeholders.

Following Demo Day, three companies will be selected for the Top 3 Showcase and receive further product development support through the partners' laboratories. These activities are expected to begin in mid-February 2027 and may include formulation development, processing trials, sensory improvements, texture optimisation and scale-up assessments.

The collaboration brings together Bühler's expertise in food processing and industrialisation, Givaudan's capabilities in flavour and sensory solutions, Ingredion's knowledge of texture and healthful ingredients, and AAK's expertise in fats, oils, coatings and fillings. The initiative aims to support emerging food innovators in addressing growing consumer demand for snacks that offer improved nutrition, affordability and sustainability while maintaining taste and texture.

BL Agro Goes Global; Aims to Invest ₹7,000 Crore in Tanzania across Edible Oil, Dairy, Agriculture & Manufacturing

BL Agro, one of India's leading fast-moving consumer goods (FMCG) and food manufacturing company, today announced its entry into the global market with a strategic investment of ₹7000 crore in Tanzania, Africa. The investment will be spread across phases over the next 10 years. The international expansion will focus across edible oils, dairy and animal husbandry, agriculture, research and manufacturing.

The Bareilly-headquartered company's global expansion is part of its ambition to become a ₹30,000 crore group by 2030. The investment will create an integrated ecosystem in Tanzania, combining the country's agricultural resources with Indian technology and processing expertise, with the potential to make Tanzania BL Agro's gateway to the wider East African market. It is also expected to strengthen trade, technology and economic cooperation between India and the East African nation. Edible oils will be BL Agro's primary focus. Tanzania is one of the world's leading sunflower producers and has significant oilseed potential. As part of its expansion strategy, BL Agro will set up edible oil production and processing facilities that add value locally and meet growing domestic demand.

The announcement follows a recent visit to Tanzania by a five-member BL Agro delegation, which met government representatives and stakeholders to discuss investment opportunities and a roadmap for the proposed projects. It also coincides with Tanzanian President Samia Suluhu Hassan's visit to India, during which both countries discussed ways to deepen bilateral cooperation and investment.

Commenting on the expansion plans, Ashish Khandelwal, Managing Director, BL Agro, said, "Tanzania offers immense growth potential for BL Agro. Tanzania is an agriculture and livestock powerhouse with significant headroom to raise productivity, and that is where Indian technology and processing expertise can make a real difference. Tanzania presents significant opportunities across agriculture, food processing, dairy and allied sectors that would act as a key growth driver for BL Agro. We have planned a ₹7000 crore investment that is aimed at creating long-term partnerships to create value for local communities. This is also designed to bring Indian expertise, technology and industry experience to Tanzania. We look forward to working closely with the Tanzanian government and local stakeholders to develop a sustainable and mutually beneficial business ecosystem."

"Tanzania Government welcomes BL Agro Industries Limited proposed INR 7000 crores investment in Tanzania. It is indeed a testament to Tanzania's rich potential in agriculture, edible oils, dairy and food processing, and to the growing warmth of India – Tanzania trade and investment ties. This collaboration will bring valuable technology, create jobs, nurture skills, and most importantly empower our farmers through local value addition and sustainable growth. We see this as the beginning of a strong mutually beneficial long-term friendship", said Anisa K. Mbega, High Commissioner of the United Republic of Tanzania to India.

BL Agro will also leverage its growing expertise in animal husbandry and dairy industry by exploring modern dairy infrastructure and unlock massive opportunities to strengthen Tanzania's livestock ecosystem. The company is also evaluating collaboration with local farmers through contract farming and agricultural supply-chain development. These initiatives could support local production and build stronger linkages between farmers, processing infrastructure and markets.

BL Agro is also exploring opportunities aligned with Tanzania's Building a Better Tomorrow (BBT) programme. The investments will focus on technology transfer, employment generation, agricultural development, local value addition and stronger supply chains. Through an integrated approach spanning agriculture, animal husbandry, food processing and manufacturing, BL Agro aims to contribute to Tanzania's industrial and economic development.

Sarson Sankalp to Drive Regenerative Mustard Farming



The Solvent Extractors' Association of India (SEA), AWL Agri Business Limited, Solidaridad Network Asia Limited and Bharatkhand Foundation have joined hands to launch Sarson Sankalp, a five-year farmer-focused programme to promote regenerative mustard farming across Bundi, Tonk and Jhalawar districts of Rajasthan. Supported through AWL's Corporate Social Responsibility (CSR) programme, the initiative aims to improve soil health, climate resilience, water and input efficiency, biodiversity and farm-level outcomes. The Memorandum of Understanding (MoU) was signed during SEA's Annual General Meeting and Annual Awards Function at The Westin Mumbai, Powai Lake.

With a total budget of Rs. 16 crore, the programme will initially target 15,000 active farmers during FY 2026-27, with plans to expand its reach to 40,000 farmers by FY 2030-31. Its interventions will include farmer training, demonstration and model farms, soil and crop advisory, field-level support, farmer record management and performance monitoring. The programme will also promote improved crop nutrition, efficient resource utilisation and sustainable agricultural practices, enabling farmers to adopt regenerative techniques through practical, field-based learning.

Under the partnership, AWL Agri Business will provide CSR support, while SEA will coordinate the programme and undertake qualitative monitoring. Solidaridad Network Asia will contribute technical expertise, programme guidance, quality assurance and knowledge support, with Bharatkhand Foundation serving as the principal field implementation partner.

According to Angshu Mallick, Executive Deputy Chairman, AWL Agri Business Limited, the initiative provides a long-term platform to demonstrate practical regenerative farming solutions and measure their impact on farmers and agricultural ecosystems. SEA representatives highlighted the programme's role in strengthening farming communities and supporting India's oilseed self-reliance. The partners aim to establish a scalable model for regenerative mustard cultivation that improves soil health, productivity, resource efficiency and climate resilience while supporting farmers' long-term wellbeing.

Third Wave Coffee Marks 10 Years of Brewing, Building Communities and Shaping India's Coffee Culture

THIRD WAVE COFFEE

Third Wave Coffee, one of India's beloved coffee and food QSR brands, marks its 10th anniversary today , celebrating a decade of growth from its Bengaluru roots into a national café brand. Founded in 2016, the brand now has 250+ cafés across 27 cities, with an ambition to reach approximately 320 cafés by FY27, and thereafter, add 100 new cafés every year. Over the past decade, Third Wave Coffee has built an increasingly diverse ecosystem spanning coffee, beverages, food, desserts, community engagement, and at-home coffee. With 100% of its coffee sourced from Indian farms, the brand has also placed Indian coffee origins at the centre of its offering.

"When we started Third Wave Coffee, specialty coffee was still a relatively unfamiliar proposition for a large part of India. What has been exciting over the last decade is seeing the category develop alongside consumers, and watching coffee become part of a much broader everyday culture. We believe India's coffee journey is only getting started," said Anirudh Sharma, Co-Founder, Third Wave Coffee.

As the brand has grown, its offering has expanded beyond coffee to encompass a wider range of consumption occasions. Over the decade, Third Wave Coffee's menu has evolved to include offerings across dayparts, pizzas and handcrafted sandwiches to an assortment of bakes and sweets. Its beverage portfolio has also continued to evolve through limited-time offerings, including the Omakase style Backroom Brews range and espresso tonics, alongside trend-led additions such as Matcha and, more recently, Ube-based drinks. Together, these innovations have made discovery an ongoing part of the café experience. Launched earlier this year, Third Wave Coffee's 'Third Rush Desserts' proposition brings a dedicated focus to indulgent desserts within the café experience.

Beyond its food and beverage offerings, Third Wave Coffee has focused on deepening consumer relationships through its digital ecosystem and loyalty programme, enabled through its app. Through community events, workshops, and collaborations, alongside partnerships spanning fashion, technology, culture, and lifestyle, the brand continues to create meaningful consumer touchpoints and foster a strong sense of community.

"The last decade has fundamentally changed the role of the café in India. For us, the opportunity ahead is to build on the foundation we have created, while continuing to develop the experience around coffee. The next phase will be about scaling our presence pan-India, creating stronger connections with consumers, and giving them more reasons to make Third Wave Coffee part of their everyday lives," added Rajat Luthra, CEO, Third Wave Coffee.

As it enters its second decade, Third Wave Coffee remains focused on expanding its presence while strengthening its role in India's coffee and café landscape.

Life Cycle Assessment: A Holistic Approach to Sustainability

Preservatives containing green toluene pass practical testing in life cycle assessment





Matthias Kunze, Business Development Manager, LANXESS

How can you measure a product's sustainability?

The most common method to date is to calculate a product's CO_2 footprint. This method focuses exclusively on greenhouse gas emissions and their impact on climate change and global warming. This includes CO_2 emissions from the company's own production and emissions from the energy purchased for that purpose, as well as the CO_2 content of the raw materials used and emissions caused by logistics.Go Green However, Life Cycle Assessment (LCA) is also increasingly being used—a method already employed by numerous companies in the chemical, packaging, and consumer goods industries. This method considers a significantly broader spectrum of environmental impacts to determine a product's environmental footprint. LCA is based not only on a single metric but on multiple indicators—each specific to the environmental category under consideration. These categories include, for example:

- Resource use
- Ecotoxicity, i.e., the impact of substances on freshwater ecosystems
- Acidification of soil or water
- Ozone Layer Depletion
- Eutrophication of water bodies
- Land use

The CO_2 footprint is therefore well-suited for quantifying progress toward climate goals using a single metric; Life Cycle Assessment, on the other hand, takes a more holistic view of sustainability and provides a metric for each category examined.

How sustainable is a product according to Life Cycle Assessment?

Matthias Kunze, Business Development Manager at the speciality chemicals company LANXESS, examined how LCA criteria affect the evaluation of a specific product using the example of the sodium benzoate "Purox S Scopeblue." The product is used as a preservative in personal care products, food, and pharmaceuticals. In the manufacturing process, conventional toluene is replaced with "green" toluene made from 100 per cent used cooking oil. This alone significantly reduces the product's CO_2 footprint. LANXESS's "Scopeblue" products either contain at least 50 per cent sustainable raw materials or have a CO_2 footprint that is at least 50 per cent lower than that of conventional products.

When evaluated according to LCA criteria, conventional sodium benzoate also performs very well. In nearly all LCA categories, the use of "green" toluene derived from used cooking oil in the production of sodium benzoate has a significantly positive impact. Particularly in the categories "resource use" and "acidification," the values are lower compared to sodium benzoate made with conventional toluene. Matthias Kunze: "Preservatives such as sodium benzoate sometimes carry disproportionate weight in specific environmental categories within the LCA, even though they often make up less than one percent of a formulation. "

In some categories, however, there are also opposing effects, albeit at a low level. Plant based products sometimes perform significantly worse than petrochemical products. In the case of sodium benzoate with "green" toluene, the value increases by about 30 percent in the "eutrophication of water bodies" category. However, it is still significantly lower than that of sustainable products based on plants grown specifically for that product. Even in the "land use" category—that is, environmental impacts resulting from the use or conversion of land—the use of "green" toluene has only a slightly negative effect.Go Green

Determination of the Life Cycle Assessment

When conducting the LCA, LANXESS follows the "cradle-to-gate" approach, which includes the raw materials used, transportation to the production site, and production—including the energy used for this purpose—in the life cycle assessment of the respective product. Additionally, the output of the manufacturing process—such as water and air emissions—is factored into the assessment. Matthias Kunze adds: "Beyond the aspects of traditional LCA analysis, there is another factor to consider with preservatives: they extend a product's shelf life both in retail and during use by consumers. Ultimately, this helps prevent waste and conserve resources—a positive factor for the life cycle assessment that is becoming increasingly important in holistic sustainability evaluations."

Conclusion

Life Cycle Assessment (LCA) does not merely determine a single sustainability metric for a product, as is the case with the CO_2 footprint. It examines a wide range of environmental categories. Manufacturers or consumers must therefore select the categories that are relevant to their decisions and their assessment of a product. Purox sodium benzoate performs well in both analysis methods. The already low CO_2 footprint of the conventional product variant is reduced even further through the use of a recycled raw material—toluene derived from used cooking oil.

Within the life cycle assessment, the conventional sodium benzoate already achieves a good result in all categories compared to other preservatives. The "green" variant delivers even better values in almost all LCA categories. Exceptions are the aspects "land use" and "eutrophication of water bodies"; here, the environmental performance deteriorates slightly. However, compared to other preservatives, the values in these categories remain at a very low level. Purox S Scopeblue is therefore already well-equipped today for a holistic sustainability assessment, which will become increasingly important in the future.

Westfalia Fruit launches updated

Sustainability Strategy, building on 58% renewable electricity



Westfalia Fruit, a global leader in the avocado industry, has launched an updated global Sustainability Strategy built around four priorities: efficient water use, carbon management, waste reduction, and biodiversity protection. The strategy is already visible across the business. The share of renewable electricity in the company's operations has risen from 18% in 2021 to 58% in 2025 and the company is working with growers and other international fresh produce companies on water in Chile's Aconcagua Valley.

Westfalia Fruit's story began in South Africa more than 77 years ago, founded on environmental and social principles rooted in the legacy of Dr Hans Merensky. Since then, the company has grown into one of the most diverse avocado growers in the world, farming across the Americas and Africa, with a long legacy of farming in harmony with nature that still shapes how it farms, researches and invests today.

The updated strategy reflects where Westfalia Fruit wants to go as a business. As the company sharpens its focus on avocados, it wants to lead on the issues that matter most for the future of the category, from water and climate to biodiversity, and give customers credible evidence of its progress. Developed with specialist support from NewForesight, the strategy is shaped by where the business has the greatest impact and by what customers, retailers and regulators expect. Each business unit has its own roadmap for water, carbon, waste and biodiversity, based on the risks and opportunities in its region, with carbon linked to the Group's long-term target of Net Zero greenhouse gas emissions by 2049.

Renewable electricity

In 2025, Westfalia Fruit's renewable electricity consumption reached 34,653 MWh, supported by both on-site solar generation and certified renewable electricity purchased through instruments such as I-RECs and Guarantees of Origin. The share of renewable electricity across our operations increased from 18% in 2021 to 58% in 2025. This transition has contributed to a ~50% reduction in Scope 2 emissions over the same period. Several packhouses across the UK, Peru, Chile, the US and France now operate on 100% renewable electricity, demonstrating the progress made in transitioning our operations away from non-renewable electricity sources.

Carbon in trees and soil

On its farms, Westfalia Fruit has partnered with One Carbon World to measure how much carbon is stored in its trees and soil. Baselines have been established on eight farms in Chile, Peru and South Africa, giving the company a clearer picture of the role its orchards play in its overall carbon balance.

Water in the Aconcagua Valley

In Chile's Aconcagua Valley, one of the country's important fruit-growing regions, Westfalia Fruit is a partner in the WAVE Aconcagua Collective Action Project. Since 2021, the project has brought together 15 producers, international fresh produce companies, government and technical partners to tackle risks that no single farm can solve on its own, such as water scarcity, soil health and biodiversity loss. The project has developed farm-level roadmaps and joined the Mesa Hídrica del Valle del Aconcagua, the main forum for water management in the valley.

"Sustainability has been part of how we farm from the very beginning," says Johnathan Sutton, Chief R&D and Sustainability Officer at Westfalia Fruit. "What is different now is that we measure it site by site and act on what we find. Going from 18% to 58% of renewable electricity shows what that approach can do. We want to bring the same discipline to water, carbon, waste and biodiversity, working closely with growers, customers and partners as we go."

The same roadmaps cover waste and biodiversity. In South Africa, for example, customer fulfilment centres in Midrand are moving to 100% recyclable packaging for avocado and mango products by the end of 2026. On biodiversity, reforestation and pollination work in Peru is helping to restore natural ecosystems in the regions where the company grows.

For customers, the strategy means clearer information on how their fruit is produced: what has already been achieved, what is still being built and where working together can speed up progress. The same long-term thinking shapes how Westfalia Fruit works with growers and their communities, from its own orchards to partnerships with smallholder growers.



Cirkla, Belmark, and Ossid Unite to Launch the World's First Resealable Fiber Tray Packaging Solution Across Food Categories



Cirkla, Belmark inc, and Ossid today announced the launch of a groundbreaking integrated packaging solution that brings resealable lidding film to fiber trays for the first time – a combination the packaging industry has never seen at commercial scale. Pairing Cirkla's high-performance fiber trays with Belmark's resealable lidding film and Ossid's automated sealing technology, the solution works across fresh protein, produce, ready meals, and other food applications.

Cirkla has already solved the industry's core challenge – high-performance fiber packaging that is sustainable, scalable, and cost-competitive with plastic. But resealable lidding film on a fiber tray has never been done before. The peel/reseal functionality that consumers expect has been exclusively the domain of rigid plastic, not because it was the right answer, but because no one had cracked the technical challenge of bonding a resealable film to a fiber substrate without compromising the tray's liner. This collaboration solves that.

Cirkla enters this collaboration on the back of significant commercial momentum. Its fiber trays meet or beat plastic on shelf life, barrier properties, and durability, reducing plastic waste by up to 90% – all while coming in at a cost that makes the switch a straightforward business decision, not a compromise. Proven in real production environments with some of the largest retailers and protein processors in the U.S., and with its first U.S. manufacturing facility set to commence operations in Gainesville, Georgia in Q1 2027, Cirkla brings to this partnership a commercially validated, supply chain-ready foundation. Their trays are plug-and-play, tested and validated on all major tray sealers in the U.S. market, including Ossid – with no capital investment or line changes required.

"Resealable fiber packaging has been one of the industry's most sought-after innovations and it took the right partners to make it real. I believe this will be the inflection point for fiber packaging adoption across the industry. When you convert a single-use tray into a resealable, multi-use package without compromising performance, cost or asking brands to change their lines – you remove every reason not to switch," said Glenn Divers, Vice President of Sales, Cirkla.

Belmark's advanced lidding film technology is the missing piece that makes resealable fiber packaging possible at commercial scale. Through its collaboration with Cirkla and Ossid, Belmark has demonstrated that sustainability, product protection and consumer convenience are no longer a trade-off.

"Projects like this are a reminder that innovation doesn't happen in isolation. Bringing resealable functionality to a fiber tray required expertise across materials, film, and equipment, and each partner played an important role. At Belmark, we're proud to contribute our leadership in lidding film technology to help bring solutions like this to market," said Jason Vandeloo, Director of Business Development, Belmark.

Ossid, the North American distributor of Reepack and a ProMach product brand, brings the sealing technology to this solution with its ReeMaster NextGen Automatic Tray Sealer. Purpose-built for medium to large-scale production environments across produce, protein, and other food applications, the ReeMaster NextGen combines servo-driven indexing conveyors and side grippers for precise, consistent tray positioning with a stainless steel, washdown-ready, open-frame design for fast, tool-free cleaning and maintenance. A 12-inch color touchscreen with intuitive recipe management simplifies operation and speeds changeovers between packaging styles, including top-seal, Modified Atmosphere Packaging (MAP), and Vacuum Skin Packaging (VSP).

"Sustainable packaging advances when partners challenge what the industry has accepted as impossible. Together with Belmark and Cirkla, we solved a long-standing challenge: pairing a fiber-based tray with a peel/reseal lidding film without damaging the tray's liner. The result is a package that performs on the line, stands out on the shelf, and helps our customers reach their sustainability goals," said Andrew Birdwell, Vice President of Sales, Ossid.

SIG launches SIG CleanClic Connect, a bag-in-box fitment innovation for easy connecting and dispensing in foodservice

SIG announced the launch of SIG CleanClic Connect, a bag-in-box fitment innovation designed to enhance dispensing flexibility and simplify operations for customers across food and beverage applications in the foodservice industry. As beverage programs evolve, manufacturers and foodservice operators need packaging solutions capable of supporting both established and emerging product categories. SIG CleanClic Connect offers application versatility for products such as beverage concentrates, refreshers, teas, creamers, shake mixes, and more helping operators respond to changing menus and consumer preferences without adding unnecessary complexity.



"Foodservice is rapidly evolving as operators introduce new beverage concepts and look for more versatile ways to serve consumers," said Jana Martin, Sr. Manager Global Marketing Foodservice at SIG. "SIG CleanClic Connect reflects how SIG helps customers connect products to dispensing systems with confidence, simplify operations through advanced product protection and aseptic technology, and create opportunities to grow by supporting a broad range of beverage and foodservice applications. It's a future-ready bag-in-box fitment solution designed to help customers adapt and succeed in a changing marketplace."

Developed with the operational realities of

dispensing in mind, SIG CleanClic Connect is easy to attach and includes a positive reclosure mechanism. Before its first connection, the SIG CleanClic Connect features a hermetic seal that helps protect product quality and support aseptic integrity, while its compatibility with bag-in-tray systems enables use across a range of dispensing environments. The innovation lies in how the fitment connects, dispenses, and recloses. During use the probe connects with the internals of the fitment, allowing it to open and product to flow. When the package is disconnected, the plug returns to an interference-fit position that positively recloses the fitment. This integrated connection and reclosure design keeps the product path open during dispensing and closed while servicing, helping to reduce exposure, leakage, product waste, and handling complexity compared with fitments that do not positively reclose.

"Our goal was to translate real customer needs into a simple, dependable bag-in-box fitment," said Steve Ditore, the SIG engineer who led its development. "SIG CleanClic Connect combines an intuitive connection with reliable reclosure and product protection. Its compatibility across applications can help foodservice operators simplify changeovers and get more value from their dispensing programs. The SIG CleanClic Connect is engineered to help customers and foodservice operators future-proof their products with a solution designed for recycling streams where available."

SIG CleanClic Connect delivers a user-friendly, connect-and-go experience from package installation through product use, creating value through improved product consistency, reduced product waste, and enhanced speed-of-service. By combining bag-in-box packaging with advanced dispensing technology, SIG CleanClic Connect reflects SIG's commitment to helping foodservice operators connect innovation with execution, simplify operational complexity, and unlock opportunities to grow while shaping the future of dispensing.

"At SIG, innovation is not a one-time achievement. It has defined our company and guided more than 70 years of partnership within the foodservice industry," said Chris Johns, General Manager America North and Global bag-in-box & spouted pouch at SIG. "SIG CleanClic Connect is a testament to that legacy, demonstrating how we continue to develop forward-thinking solutions that address today's challenges while preparing for tomorrow's opportunities. As we look ahead, SIG remains dedicated to leading the evolution of the bag-in-box industry through continuous innovation, customer-focused advancements, and commitment to shaping the future of foodservice for decades to come."

Learn more about SIG CleanClic Connect: https://www.sig.biz/en/solutions/package-finder/sig-cleanclic-connect

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UPM, Uteco and Siegwerk introduce a paper-based solution for secondary packaging



UPM Specialty Materials, Siegwerk and Uteco have developed a paper-based solution for secondary packaging. UPM provides the barrier base paper, Siegwerk the coating and Uteco the technology that applies it. Designed as a practical entry point into paper packaging, the solution allows brand owners to increase renewable material content and test paper-based formats in demanding applications, while the primary packaging continues to safeguard product integrity.

"As packaging legislation, such as EU PPWR, evolve globally, brand owners need practical ways to reduce plastic without compromising performance. Together with Uteco and Siegwerk, we have shown that paper content can be increased to up to 90% in such packaging, while maintaining the performance required for demanding applications," says Marco Tramontano, Sales Director, UPM Specialty Materials.

Designed for brand owners, converters and machine builders, the solution combines UPM barrier base paper with Siegwerk's CIRKIT BAR SEAL coating, precisely applied using Uteco's high-definition flexographic technology to deliver moisture and grease resistance, heat sealing and recyclability through standard paper recycling streams (CEPI/4evergreen v2).

"Coatings play a critical role in enabling the next generation of paper packaging. By applying our CIRKIT BAR SEAL technology onto UPM's barrier paper using Uteco's advanced flexographic process, we have created a recyclable paper-based solution that delivers the functional performance converters and brand owners expect. This project shows how innovation in coatings can help unlock new opportunities for reducing dependence on fossil-based packaging materials," says Gilles Le Moigne, Head of Circular Economy Coatings at Siegwerk.

"Our joint production trial showed that paper packaging can perform efficiently at industrial scale. By integrating coating, printing and heat sealing in a single pass, made possible by advanced technology and the right equipment, this solution helps converters produce functional paper packaging while saving time, energy and production costs," says Uteco's Printing & Technical Department.

CellShield® Protopia™ Protective board



Eurobrillance, Plastigraf Trevigiana, NatureWorks, and Form iQ Collaborate to Advance Biobased Paperboard Packaging

NatureWorks™

Eurobrillance, Plastigraf Trevigiana, NatureWorks and Form iQ have collaborated to develop a biobased paperboard packaging solution offering grease resistance, barrier performance and heat sealability for food packaging applications. The solution, named CellShield® Protopia™, combines Eurobrillance and Plastigraf Trevigiana's coating and lamination technologies with NatureWorks' Ingeo™ biopolymer technology and Form iQ's thermoforming expertise. The collaboration aims to advance high-performance fibre-based packaging using renewable materials while supporting recyclable and compostable packaging solutions.

CellShield Protopia offers two barrier technologies: lamination and dispersion coating. The lamination approach combines thin biobased BOPLA films with paperboard using a compostable water-based adhesive, providing heat-sealing capabilities and additional barrier protection for applications such as thermoformed trays. The dispersion coating technology uses a water-based Ingeo biopolymer coating applied in thin layers through existing coating equipment, offering a lightweight solution for frozen food packaging and products with shorter shelf lives.

The partners have also demonstrated the technologies through industrial thermoforming trials to produce paperboard trays with barrier performance and production efficiency comparable to conventional PET-laminated paperboard. The trials achieved forming times of approximately 0.2 seconds and an average of 27 mould-closing cycles per minute for containers with a depth of 35 mm. The results highlight the potential of combining renewable material development with industrial processing capabilities to advance scalable, high-performance and sustainable food packaging solutions.

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