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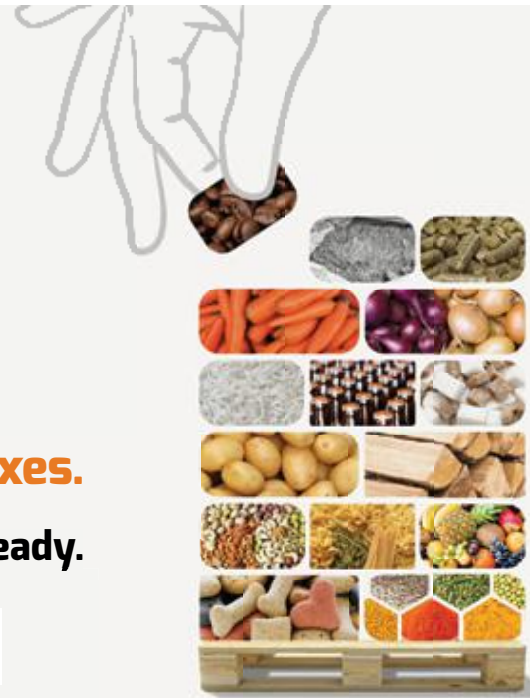
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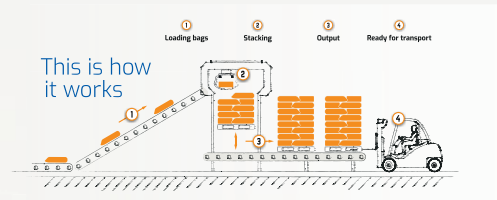


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Dear Readers,

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

Innovation continues to reshape the food and beverage industry, with advancements in automation, food safety, sustainable packaging, and functional ingredients driving the next phase of growth. In this August 2026 edition of Food & Beverage Processing Magazine, we bring you a selection of insightful articles and expert perspectives on the technologies and trends transforming the industry.

Our Processing Technology segment highlights the rapid evolution of smart manufacturing with an in-depth feature on the Food Automation Market, examining how robotics, artificial intelligence, and connected production systems are driving productivity, consistency, and operational excellence across food manufacturing facilities. We also explore Biosensors Transforming Food Safety, showcasing how next-generation sensing technologies are enabling faster detection of contaminants, enhancing quality assurance, and strengthening food safety throughout the global supply chain.

In our Packaging Technology section, we focus on the innovations redefining product protection and consumer convenience. Our feature on RTD Packaging: Convenience Meets Sustainability explores how the growing demand for ready-to-drink beverages is encouraging the adoption of lightweight, recyclable, and environmentally responsible packaging solutions. We also examine The New Face of Food Packaging: What's Driving Industry Change Today, providing insights into the technological advancements, sustainability initiatives, smart packaging developments, and evolving consumer preferences that are influencing packaging strategies worldwide.

The Ingredients & Additives segment celebrates both tradition and innovation. Our feature on Black Pepper: The Timeless King of Spices in Modern Food Innovation revisits one of the world's oldest and most valued spices, highlighting its enduring significance in culinary applications, food processing, and health-focused product development. We also explore the growing popularity of Clear Whey Protein, an emerging category that is reshaping the sports nutrition market with its light, refreshing, and functional appeal, meeting the increasing consumer demand for convenient, high-protein beverages.

Adding further value to this edition are two exclusive industry interactions with distinguished leaders. We feature T. K. Radhakrishnan, Vice President – Food Systems Business Unit, HRS Process Systems Ltd., and Anirudh Khanna, Managing Director, Independence Brewing Company.

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

We encourage you to continue sharing your valuable feedback with us at info@dvrpublication.com.

Wishing India Foodex - 26, Food Pro- 26, Fi India- 26. Propak India - 26, all the best !!!

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Director, Independence Brewing
Company**

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Anmol Brings the Taste of Kachori and Pickles to Every Crunch with New Mini Crackers



Anmol Industries, one of India's leading biscuit and bakery brands, has expanded its savoury snacking portfolio with the launch of Anmol Mini's Kachori Masala and Anmol Mini's Achari Masti. Inspired by the rich flavours of Indian street food and traditional pickles, the new bite-sized crackers offer a crunchy and flavourful snacking experience at an affordable price of ₹10.

Crafted for consumers seeking convenient, on-the-go snack options with authentic Indian flavours, the Mini Cracker range delivers the bold taste of Kachori Masala and the tangy zest of Achari Masti in a crisp, baked format. Their compact size makes them an ideal companion for tea time, travel, office breaks, school tiffins, and anytime snacking.

The new variants have been introduced to cater to the growing demand for savoury snacks that combine familiar regional flavours with the convenience of packaged foods. Available in a pocket-friendly pack priced at ₹10, the products are designed to make flavourful snacking accessible to consumers across all age groups. The newly launched Anmol Mini's Kachori Masala and Mini's Achari Masti will be available across North India through the company's extensive General Trade (GT) distribution network.

Commenting on the launch, Mr. Aman Choudhary, Executive Director – Marketing, Anmol Industries Limited, said: "Indian consumers have a strong affinity for

traditional flavours, and we wanted to recreate those familiar taste experiences in a convenient baked snack format. With Mini's Kachori Masala and Achari Masti, we are bringing together the crunch of baked crackers with the bold and exciting flavours that people love. At an affordable price point of ₹10, we believe these products will become a preferred everyday snack for consumers across the country."

The launch is part of Anmol Industries' ongoing strategy to strengthen its presence in the savoury snacks segment while continuously innovating to meet evolving consumer preferences. The company has consistently expanded its portfolio with products that balance taste, quality, affordability and convenience.

With the introduction of Mini's Kachori Masala and Achari Masti, Anmol Industries further reinforces its commitment to offering innovative snacking options inspired by Indian tastes while ensuring they remain accessible to consumers across urban and rural markets.

Beyond Snack Expands Portfolio with ZERO and VIBE Banana Chip Ranges

Beyond Snack, one of India's rapidly growing premium banana chips brands, has expanded its product portfolio with the launch of Beyond Snack ZERO and Beyond Snack VIBE, introducing two new offerings aimed at meeting evolving consumer preferences while strengthening its position in the premium snacking market.

Beyond Snack ZERO has been developed with a focus on clean-label ingredients. Created over four months, the range is made without palm oil, preservatives, added colours, or refined sugar, while retaining the brand's signature taste and crunch. Available in Original Style, Peri Peri, and Salt & Black Pepper variants, the products are offered in 50g packs through quick-commerce platforms including Blinkit, Zepto and Swiggy Instamart, as well as premium retail outlets across major cities such as Mumbai, Delhi NCR, Bengaluru, Hyderabad, Chennai and Pune.

The company has also introduced Beyond



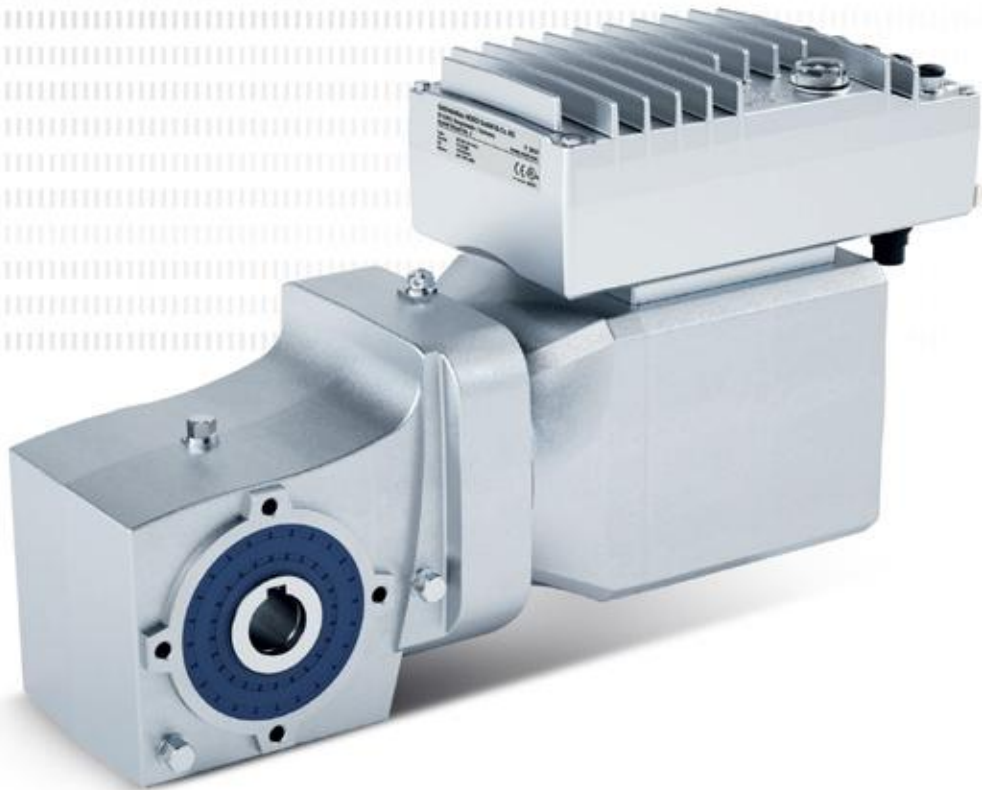
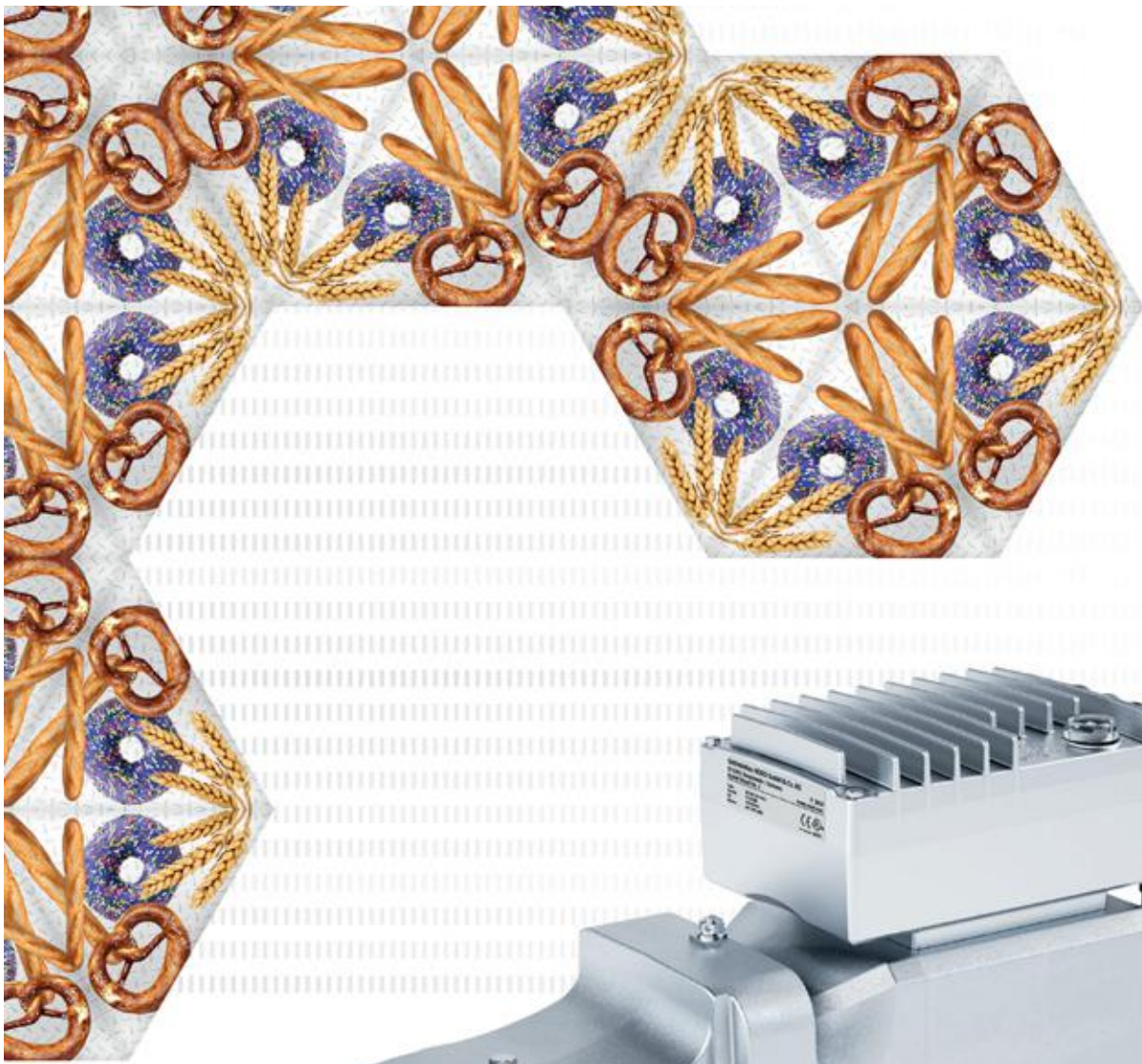
Snack VIBE, featuring a distinctive vertical-cut banana chip designed for sharing and social snacking occasions. The inaugural Masala Mingle flavour combines a new chip format with a flavour profile tailored for consumers seeking a differentiated snacking experience. VIBE is available through quick-commerce

platforms, modern trade and retail outlets in metro cities in 50g and 100g pack sizes.

Commenting on the launches, Manas Madhu, Founder and CEO of Beyond Snack, said that the company remains committed to its core expertise in banana chips. He noted that every new product is designed to deliver the taste, texture and quality consumers associate with the brand while providing fresh reasons for them to choose Beyond Snack.

The new launches support Beyond Snack's broader growth strategy following revenue of ₹74 crore in the previous financial year. The company is now targeting ₹200 crore in annual recurring revenue, backed by continued investments in product innovation, manufacturing capabilities and distribution expansion.

Founded in 2020, Beyond Snack works with more than 200 farmers across Kerala through an integrated farm-to-pack supply chain. The brand has expanded its presence across quick commerce, modern trade, general trade and international markets, bringing Kerala's iconic Nendran banana chips to consumers in India and overseas.



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Lee Kum Kee Japanese Style Soy Sauce Now Available for India's Foodservice Market



India with the launch of Lee Kum Kee Japanese Style Soy Sauce. Introduced alongside its authorised and exclusive import and distribution partner for North India, Earthling Consumer Products Pvt. Ltd., the new product supports the growing demand for authentic Japanese cuisine across India's foodservice industry.

Lee Kum Kee Japanese Style Soy Sauce is naturally brewed, with the first draw essence extracted. It delivers a rich aroma with balanced umami suitable for a wide range of culinary applications. From sushi and donburi to stir-fries, marinades, glazes, grilled meats, seafood and contemporary Asian cuisine, the product enables chefs to create authentic flavours while maintaining consistency at scale. It contains no added MSG, is Halal-certified and suitable for vegetarians.

Ashok Pandey, Associate Business Director -India & MEA of Lee Kum Kee Sauce, said, "India is one of the most exciting growth markets for Asian cuisine today, and chefs need ingredients that taste right and perform consistently in their busy kitchens. The launch of the Japanese Style Soy Sauce reinforces our

commitment to supporting the continued growth of Asian cuisine in India by providing chefs with authentic, high-quality ingredients they can trust."

Speaking on the partnership, Shippy Sharma, Managing Director, Earthling Consumer Products Pvt. Ltd., said, "Japanese cuisine continues to gain wider acceptance across India's foodservice industry. Our partnership with Lee Kum Kee enables us to provide chefs and foodservice operators with high-quality ingredients that support consistency, reliability, and everyday kitchen operations."

Lee Kum Kee Japanese Style Soy Sauce is now available to restaurants, hotels, cafés, cloud kitchens and other foodservice operators in India. Lee Kum Kee Sauce operates under its "100-1=0" quality philosophy, where every detail matters. Every product marketed in India undergoes rigorous quality assurance and complies with applicable Government of India regulations, including relevant Food Safety and Standards Authority of India (FSSAI) requirements, before reaching customers.

AUM Premium Unveils Plans to Introduce 100% Plastic Free Bottles

AUM Premium, India's affirmation-led natural Himalayan spring water brand, has conceptualised paper-based bottles and plans to unveil its new packaging by the end of this year. The new packaging format is designed to minimise the use of plastic and provide a more environment friendly alternative to packaging without compromising the premium quality of the water from the bottle.

The idea is a bottle made from paper that is responsibly sourced and has a food-grade barrier to minimize the use of traditional plastic without compromising the integrity of the product. In addition, the lightweight design is expected to increase transportation efficiency and reduce the overall environmental impact associated with packaging and distribution. Through this initiative, AUM Premium aims to explore packaging solutions that combine functionality, consumer convenience and environmental responsibility.

The brand has also recently partnered with Scrapbuddy, a Delhi-based waste



management and recycling startup, to provide its customers with an easy-to-use recycling program for used bottles. This collaboration will promote responsible recycling of packaging waste, which will contribute to the development of a more circular packaging strategy and reduced landfill waste.

Speaking about the initiative, Jagriti Motwani, Founder & CEO, AUM Premium, said, "Water is a product people consume every day, but the conversation around it has largely remained

limited to purity and price. Packaging deserves equal attention. Our objective is to reduce unnecessary plastic wherever possible without compromising product quality. The paper-based bottle is one step in that direction, and we will continue exploring better alternatives as the technology evolves."

The industry standard for bottled water is conventional plastic packaging, but AUM Premium has decided to go a different route from the start. AUM Premium is more than a hydration brand, it is a business built on philosophy: Affirm, Uplift and Manifest, and has always believed that creating a premium product goes beyond the water itself, it extends to every choice that shapes the consumer experience. The paper-based bottle reflects this vision, responding to the growing demand for more conscious consumption while preserving the premium experience that defines the brand. As AUM Premium moves into its next phase of growth, the brand remains focused on rethinking every aspect of the consumer experience. With plans to introduce 100% plastic-free bottles it aims to take a meaningful step towards more responsible packaging while continuing to offer consumers a premium hydration experience.

ITC launches Sugar Free Coconut Cola Under B Natural Brand

ITC Limited has entered India's carbonated soft drink market with the launch of B Natural Sugar Free Coconut Cola, marking its strategic expansion into the rapidly growing low sugar beverage segment. Priced at ₹60 for a 250 ml pack, the premium beverage is initially being introduced through quick commerce platforms as part of a pilot rollout. The launch strengthens ITC's presence in the premium beverages category, where rising consumer demand for healthier and low sugar alternatives is reshaping the market. The company plans to gradually expand distribution across e-commerce platforms, modern retail outlets and traditional trade channels.

Speaking about the company's growth strategy, Sanjiv Puri, Chairman and Managing Director of ITC, said the beverages business will continue to expand with new flavours, variants and pack sizes. He added that growth will be driven through e-commerce, modern trade and conventional retail channels, with a strong focus



on the premium end of the beverage market. With the introduction of B Natural Sugar Free Coconut Cola, ITC joins the competition in India's carbonated soft drink segment alongside domestic challenger Reliance's Campa brand and global beverage leaders Coca-Cola and PepsiCo, as demand for better for you refreshment options continues to grow.

Nestlé Professional Singapore Launches KITKAT® Chocolate Drink for Foodservice



Nestlé Professional Singapore has launched the new KITKAT® Chocolate Drink, bringing the iconic "Have a Break, Have a KITKAT®" experience to cafés, restaurants, hotels and foodservice outlets across Singapore. Available hot or iced, the creamy chocolate beverage combines the signature taste of KITKAT® with its distinctive wafer notes, and is already being served at leading operators including Burger King, Nan Yang Dao, Kopitiam and Koufu. Designed for the foodservice sector, the drink offers operators a globally recognised brand with convenient preparation and consistent quality. The launch also reinforces Nestlé's sustainability commitment, as the cocoa used in KITKAT® is responsibly sourced through the Nestlé Cocoa Plan, which supports cocoa farming communities and promotes sustainable cocoa production worldwide.



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SunBridge Consumers Enters India's Nutrition-Led FMCG Market with Launch of Health-Focused Brands



SunBridge Consumers, the FMCG arm of SunBridge Group, has entered India's nutrition and FMCG market with the launch of its first portfolio of brands—AlphaKid, KidZola, Frooney, and LifeJoy—aimed at helping Indian families make healthier

everyday choices. Backed by SunBridge Group's four decades of expertise in agri-processing and food commodities, the portfolio combines modern food science, carefully selected ingredients, and clean-label formulations focused on nutrition, functional benefits, and everyday wellness.

AlphaKid is a nutraceutical milk mix formulated with ghee, jaggery, and cereal mix, containing 19 essential nutrients and 12 vital actives to support children's immunity, brain development, gut health, and overall growth, while providing 55% of the recommended daily protein requirement when mixed with 200 ml of milk. KidZola is a low-absorption triple oil blend of rice bran, olive, and flaxseed oils powered by KidZorb™ Technology, designed

to reduce oil absorption during cooking while maintaining taste and offering a balanced SFA:MUFA:PUFA fatty acid profile. Frooney is a clean-label fruit jam made with real fruit pulp, honey, apple pectin, chicory root plant fibre, and lemon juice, while LifeJoy is a tomato ketchup made with tomatoes and jaggery, free from refined sugar, artificial flavours, colours, and preservatives.

Commenting on the launch, Anuj Agarwal, Founder and Chairman, SunBridge Group, said the inaugural portfolio reflects the company's commitment to combining science, clean-label ingredients, and thoughtful innovation to create nutrition-led products that support modern family lifestyles and make healthier choices more accessible. The company plans to expand its food and wellness portfolio with additional product launches in the coming months, reinforcing its focus on innovation, ingredient transparency, and science-backed nutrition.

Rasna Expands Jumpin RTD Portfolio with New 1-Litre Family Pack



Rasna has strengthened its ready to drink fruit beverage portfolio with the nationwide launch of the new 1 litre Jumpin Family Pack,

catering to the rising demand for premium fruit based beverages for households. The new beverage features a high fruit content and is fortified with 10 essential vitamins and minerals, expanding the existing Jumpin range, which already includes 125 ml and 200 ml packs. Manufactured and packed in India using Tetra Pak cartons under the Make in India initiative, the product will be available through modern retail outlets, traditional retail stores, e-commerce platforms, and quick commerce channels across the country.

Speaking on the launch, Piruz Khambatta, Chairman of Rasna Group, said the company is committed to offering international quality fruit beverages at affordable prices while supporting domestic manufacturing. He added that all fruits used in Jumpin are sourced and processed in India and packed in locally manufactured Tetra Pak cartons.

Khambatta also highlighted that the new range focuses on delivering better taste, real fruit content, and added nutrition. The specially developed Orange variant has been created to match the taste preferences of children. To promote the launch, Rasna will roll out an integrated marketing campaign spanning television, outdoor advertising, digital video platforms, OTT services including JioCinema/Hotstar, ZEE5, and YouTube, along with social media promotions.

Cassio Simões, Managing Director of Tetra Pak South Asia, said Indian consumers are increasingly looking for safe, convenient, and high quality beverage options. He noted that the new one litre carton has been designed to meet the evolving needs of modern families while supporting the growth of India's food and beverage industry. The new one litre Jumpin Family Pack is priced at Rs 110. Rasna will continue to offer its 125 ml Mango, Litchi, and Orange variants at Rs 10 each, along with 200 ml Tetra Pak cartons in Mango and Mixed Fruit flavours priced at Rs. 20.



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So Good Soju Enters Karnataka and Launches Three New Flavours as Demand for Korean Spirits Rises



Riding the growing popularity of Korean food, culture and flavour-forward, low-ABV beverages among young Indian consumers, homegrown craft soju brand, So Good Soju has entered Karnataka with the launch of five crowd favourite flavours – Peach, Green Grape, Strawberry, Blueberry & Green Apple. The launch marks the brand's debut in Bengaluru and is part of a broader expansion into Goa and the North East, further strengthening its presence across India's emerging craft spirits market.

With this expansion, So Good Soju's portfolio now comprises seven flavours across still and sparkling expressions—Peach, Green Apple, Yuzu Lime, K- Bomb, Green Grape, Strawberry and Blueberry. The brand is currently available across both terminals of Mumbai Airport, retail stores across Mumbai, Pune, Bangalore & Haryana, and is now extending its footprint

into one of India's most progressive beverage markets.

Rather than simply adding new variants, the launch reflects changing consumer preferences for lighter, flavour-led alcoholic beverages inspired by global drinking cultures. Korean cuisine, entertainment, and lifestyle have steadily gained popularity in India, creating a growing audience for authentic soju experiences and premium social drinking occasions. The new flavours build on the brand's philosophy of combining Korean inspiration with quality craftsmanship. Green Grape offers a crisp, refreshing profile, Strawberry delivers a vibrant fruit-forward taste balanced with bright acidity, while Blueberry brings layered berry notes with a smooth finish, broadening the brand's appeal across different consumer preferences.

Commenting on the launch, Jaspreet Singh, Founder, So Good Soju, said: "We are seeing a clear shift in how young Indian consumers are approaching alcohol. They are looking for drinks that are lighter, flavour-forward and suited to more social, experiential occasions. Bengaluru is one of India's most exciting beverage markets, making it the ideal city to introduce the next phase of our portfolio. As interest in Korean culture continues to grow, we believe soju has the potential to become an important premium drinking choice for Indian consumers."

So Good Soju's expansion into Karnataka marks another step in its national growth strategy as it builds awareness for the craft soju category in India. The new variants will be available in Maharashtra, Goa, Haryana & Punjab in the coming weeks, making its portfolio available to a wider base of consumers seeking new and globally inspired drinking experiences.

Quaker shakes up daily routines with new Oat Shake & Go



Quaker has expanded its portfolio with the launch of Quaker Oat Shake & Go, a dry oat shake mix designed to provide a quick, nutritious, and convenient option for busy consumers. Rolling out nationwide from July, the product contains 16 grams of whole grains, 15 grams of protein per serving (23 grams when prepared with 8 ounces of milk), 3 grams of fibre, and is free from artificial preservatives, flavours, and added colours. Available in Strawberry & Banana and Cinnamon Vanilla flavours, the shake is prepared by simply adding cold milk, a milk alternative, or water and shaking the bottle.

The launch follows a 49% year-over-year increase in cold-prep oat searches on TikTok, reflecting growing consumer demand for convenient oat-based nutrition. James Wade, Chief Marketing Officer for Quaker Foods, said the new product reimagines Quaker's nearly 150-year legacy by bringing the nutritional benefits of protein, fibre, and 100% whole-grain oats into a drinkable format. The company said Quaker Oat Shake & Go is intended as a convenient breakfast or snack option rather than a meal replacement and will be available in the hot cereal aisle at major retailers nationwide.



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Food Automation Market Set for Strong Growth as Smart Manufacturing Transforms Food Processing



Market Outlook

The global food automation market is entering a new phase of growth as food manufacturers increasingly adopt intelligent technologies to improve efficiency, product quality, and food safety. Rising labor costs, stricter regulatory requirements, and the need for greater operational efficiency are making automation a strategic investment rather than an optional upgrade. According to market projections, the Food Automation Market is expected to grow from USD 8.068 billion in 2025 to USD 21.22 billion by 2035, registering a compound annual growth rate (CAGR) of 10.15% during the forecast period. Automation is now transforming every stage of the food value chain, from processing and packaging to warehousing and distribution.

AI and Smart Manufacturing Lead Innovation

Artificial Intelligence (AI) and machine learning are redefining food manufacturing by enabling real-time quality inspection, predictive maintenance, and process optimization. Unlike conventional automation, AI-powered systems continuously analyse production data to identify potential issues before they disrupt operations. This helps manufacturers reduce downtime, minimize waste, improve product consistency, and achieve higher production efficiency while delivering measurable returns on investment.

Collaborative Robots Gain Wider Adoption

Collaborative robots, or cobots, are becoming increasingly popular across food production facilities. Designed to work safely alongside human operators, cobots are being deployed for repetitive tasks such as sorting, packing, palletizing, and product inspection. Their flexibility, ease of programming, and comparatively lower investment costs make

them particularly attractive for small and mid-sized food processing companies looking to automate without completely redesigning their production lines.

Automation Strengthens Food Safety

Food safety continues to be a major priority for manufacturers and regulators worldwide. Automated vision systems, X-ray inspection equipment, sensor-based detection technologies, and digital traceability platforms are helping companies detect contaminants, verify product quality, monitor hygiene compliance, and improve supply chain transparency. These technologies significantly reduce the risk of product recalls while ensuring compliance with increasingly stringent food safety regulations.

Connected Factories Improve Supply Chain Efficiency

The adoption of Internet of Things (IoT) sensors and digital twin technology is providing manufacturers with real-time visibility across the entire production and supply chain. These connected systems monitor equipment performance, track raw materials, improve demand forecasting, reduce spoilage, and enable faster responses to changing market conditions. Digital connectivity is becoming a key factor in building more resilient and efficient food manufacturing operations.

Robotics Transform Packaging and Warehousing

Automation is also reshaping packaging and warehouse operations. High-speed robotic arms, Automated Guided Vehicles (AGVs), and Autonomous Mobile Robots (AMRs) are increasingly handling packaging, pallet movement, and cold storage logistics. These technologies improve throughput, reduce

manual handling, lower operational costs, and help manufacturers overcome ongoing labor shortages in high-intensity production environments.

Key Innovations Driving Growth

Several technological advancements are accelerating the adoption of food automation in 2026. AI-enabled vision systems can detect even minute product defects in real time, improving inspection accuracy. Adaptive robotic grippers automatically adjust to products of different sizes and shapes, supporting flexible packaging operations. Cloud-connected automated kitchens are enabling high-volume food preparation with greater consistency, while predictive analytics optimize production parameters to maximize yield and minimize raw material waste. Together, these innovations are helping manufacturers meet growing consumer expectations for quality, freshness, and transparency.

Growth Drivers and Regional Trends

The market is being driven by persistent labor shortages, rising wages, stricter food safety regulations, operational cost optimization, and increasing demand for customized products with shorter production cycles. Regionally, Asia-Pacific continues to lead market expansion due to rapid industrialization and increasing investments in food processing across China, India, and Southeast Asia. North America remains a technology leader with strong adoption of smart factories, predictive maintenance, and fully integrated digital manufacturing systems. Europe continues to invest heavily in automation to improve sustainability, traceability, and regulatory compliance. Meanwhile, the Middle East & Africa are expanding automation investments to strengthen food manufacturing and cold chain infrastructure, while Latin America, particularly Brazil and Mexico, is witnessing steady growth as processors seek greater efficiency and improved product quality.

Future Perspective

The food automation market is rapidly evolving toward intelligent, connected, and highly flexible manufacturing systems. Companies investing in scalable automation, digital transformation, and advanced robotics will be better positioned to improve productivity, strengthen food safety, reduce operating costs, and meet the growing consumer demand for high-quality, transparent, and efficiently produced food products. As the industry moves forward, automation is expected to become a defining competitive advantage across the global food processing sector.

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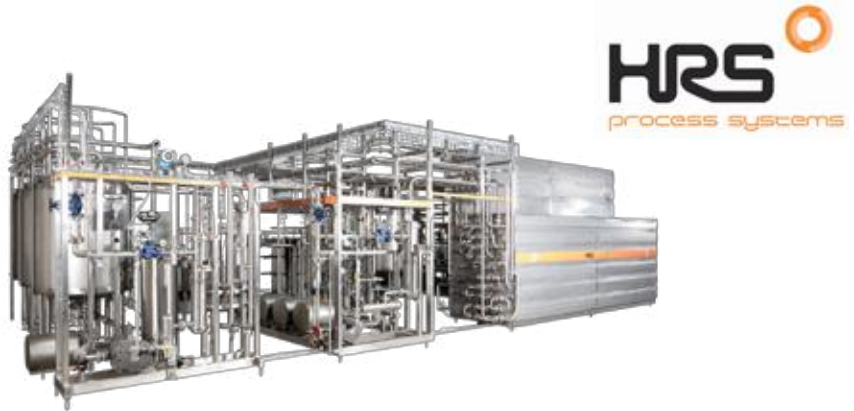
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Engineering the Future of Food Processing

T K Radhakrishnan, Vice President – Food Systems Business Unit, HRS Process Systems Ltd., shares how integrated process engineering, intelligent thermal technologies, and customer-centric innovation are helping food manufacturers build smarter, safer, and more sustainable processing facilities.



HRS Process Systems has developed a comprehensive portfolio of heat exchangers and process systems for diverse industries. Could you provide an overview of the company's core offerings and their role in modern food and beverage processing?

At HRS Process Systems, we have always believed that successful food manufacturing is built on integrated process engineering rather than standalone equipment. Over the years, our Food Systems Business Unit has evolved into a comprehensive solution provider, delivering complete thermal processing and process engineering systems that support every stage of food and beverage manufacturing. Today, our portfolio extends far beyond heat exchangers and includes pasteurization systems, UHT plants, aseptic processing and filling solutions, sterilizers, evaporation systems, aseptic storage tanks, Clean-in-Place (CIP) systems, process automation, and fully integrated turnkey processing plants.

Our solutions cater to a diverse range of industries, including dairy, plant based beverages (Coconut, soy milk, Oat milk, almond milk etc.) fruit and carbonated beverages, fruit & vegetable processing, tomato products (paste, puree, sauces and ketchup), continuous sugar dissolving & filtration, nutraceuticals, and several other liquid food applications. Every solution is designed around the customer's specific process requirement, production objectives, and future expansion plans, ensuring optimum efficiency, consistent product

quality, and long-term operational reliability.

One of the defining strengths of HRS is our ability to combine advanced heat transfer technology with deep process engineering expertise. Rather than supplying individual pieces of equipment, we engineer complete production lines where each process stage is seamlessly integrated. This approach enables customers to improve plant productivity, maintain stringent food safety standards, minimise product losses, product traceability and achieve greater operational efficiency throughout the manufacturing lifecycle.

As processing technologies continue to evolve, we are also expanding our portfolio with next-generation solutions such as our latest Falling Film Evaporator integrated with Mechanical Vapor Recompression (MVR). This represents one of our latest innovations in sustainable evaporation technology, it complements our broader philosophy of delivering complete, future-ready processing solutions that combine performance, efficiency, and product quality.

As food manufacturers increasingly prioritise efficiency, product quality, and sustainability, how is HRS Process Systems addressing these evolving requirements through its advanced heat exchanger and thermal processing solutions?

The food processing industry is undergoing a significant transformation. Manufacturers today are expected to produce higher-quality products while simultaneously reducing operating costs, improving resource utilisation, and meeting increasingly ambitious sustainability goals. Achieving these objectives requires much more than efficient equipment—it demands intelligent

process design that optimises the entire production cycle.

At HRS, our engineering philosophy is centred on delivering complete process solutions where thermal efficiency, hygienic design, process automation and product quality work together as a single integrated system. Every project begins with a thorough understanding of the customer's product, production capacity, quality expectations, and long-term business objectives. This enables us to design processing plants that maximise operational efficiency while preserving the sensory and nutritional characteristics of the final product.

Our extensive product portfolio and its integration engineered to deliver precise thermal control with gentle product handling. This is particularly important for heat-sensitive products where excessive thermal exposure can compromise flavour, colour, aroma, and nutritional value. Through optimised heat transfer and carefully controlled processing conditions, we help manufacturers consistently produce premium-quality products while improving overall plant performance.

Sustainability is another area where we continue to invest heavily in innovation. Modern food manufacturers are increasingly evaluating technologies based on lifecycle operating costs rather than initial capital investment alone. In response, HRS has developed solutions that maximise heat recovery, optimise utility consumption, and improve process efficiency across the entire production line.

A good example is our newly introduced Falling Film Evaporator using Mechanical Vapor Recompression (MVR). By recovering the vapor generated during evaporation, mechanically compressing it, and reusing it as the heating medium, the system significantly reduces steam consumption while maintaining stable evaporation performance and superior product quality. However, we view MVR not as a standalone innovation, but as part of our broader commitment to helping customers build highly efficient, sustainable, and future-ready manufacturing facilities.

We also partner and integrate HRS technology for our customers to produce value added products from by-products which generally goes as a waste.

Food safety and hygiene remain top priorities for food & beverage processors. What key design innovations and engineering features in HRS systems help manufacturers achieve high product quality while meeting global regulatory standards?

Food safety has always been the important of every solution we design at HRS Process Systems. In today's food manufacturing environment, consumers expect products that are not only safe but also consistent in taste, texture, nutritional value and shelf life. At the same time, manufacturers must comply with increasingly stringent international food safety regulations and quality assurance standards. Meeting these expectations requires hygienic engineering to be integrated into every aspect of process design rather than being treated as an additional feature.

Across our portfolio, we incorporate hygienic design principles that minimise cross contamination risks while maximising operational reliability. Our systems feature sanitary construction, high-quality alloy steel & titanium for product contact surfaces, fully drainable process layouts, automated Clean-in-Place (CIP) systems, and precise thermal control to ensure repeatable processing conditions. These design principles simplify cleaning and validation while helping manufacturers maintain the highest levels of food safety and operational efficiency.

Automation further strengthens process consistency by continuously monitoring critical process parameters such as temperature, pressure, flow rates and holding time. This level of control ensures every production cycle delivers the same quality standards while providing complete process traceability, an increasingly important requirement for both domestic and export-oriented food manufacturers.

Equally important is protecting the product itself during thermal processing. Most of the food products—including dairy ingredients, fruit juices, sauces and nutraceutical formulations—are highly sensitive to heat. Excessive thermal exposure can negatively affect flavour, colour, aroma and nutritional properties. This is where advanced processing technologies make a significant difference.

Our Falling Film Evaporator using Mechanical Vapor Recompression (MVR) is specifically engineered for concentrating heat-sensitive products. Evaporating temperature can be regulated based on product's thermal sensitivity by operating under controlled vacuum conditions. With thin liquid film flowing over the heat transfer surface at high velocity, the system ensures rapid evaporation with minimal residence time. Combined with fully automated operation and integrated CIP capability, it enables manufacturers to achieve high product quality while maintaining the hygienic standards expected by today's food industry.



Energy efficiency and carbon reduction have become strategic priorities across the industry. How do HRS technologies help customers improve heat recovery, reduce water and energy consumption, and enhance overall sustainability?

Sustainability has become one of the defining priorities for the global food processing industry. Manufacturers are no longer evaluating equipment solely on production capacity—they are equally focused on reducing operating costs, lowering resource consumption and meeting increasingly ambitious environmental commitments. We believe that sustainable manufacturing begins with intelligent process engineering, where every stage of production is designed to maximise efficiency while minimising waste.

At HRS Process Systems, sustainability is integrated throughout our product portfolio. Our advanced heat exchangers are designed to maximise thermal recovery, enabling valuable process heat to be reused rather than discarded. Our thermal processing systems optimise steam utilisation, minimise cooling requirements and improve overall utility efficiency across the plant. By combining intelligent heat integration with efficient process design, customers are able to reduce both operating costs and environmental impact over the lifetime of the facility.

Automation also plays a significant role in sustainability by ensuring utilities are consumed only when required and under optimal operating conditions. Intelligent process control reduces unnecessary energy usage, improves process stability and helps manufacturers consistently achieve higher levels of operational efficiency.

One of our most significant innovations



in this area is usage of Mechanical Vapor Recompression (MVR) in Evaporator. Traditional evaporation systems require a continuous supply of fresh steam, making evaporation one of the most energy-intensive operations in food manufacturing. MVR technology fundamentally changes this process by recovering the vapor generated during evaporation, mechanically compressing it and reusing it as the heating medium. This closed-loop approach allows approximately 100% of the steam energy to be recycled, significantly reducing steam demand while lowering operating costs and carbon emissions.

However, we see MVR as part of a much broader sustainability strategy. When combined with efficient heat recovery, intelligent automation and optimised process integration, it enables manufacturers to build production facilities that are not only economically competitive but also environmentally responsible for the long term.

Smart manufacturing is becoming the norm. How is HRS leveraging automation, digital monitoring, and intelligent process controls to improve operational efficiency, predictive maintenance, and process reliability?

Digital transformation is fundamentally reshaping the way food processing plants operate. Today's manufacturers require more than automated equipment—they need intelligent production systems capable of delivering consistent quality, real-time process visibility and actionable operational insights. At HRS, automation is no longer viewed as an optional enhancement; it has become an integral part of every process solution we deliver.

Our systems are equipped with advanced PLC and SCADA platforms that provide

operators with complete control over critical production parameters. Real-time monitoring of temperatures, pressures, flow rates and product conditions ensures consistent processing while significantly reducing operator dependency. Recipe management, automated production reporting, batch traceability and alarm diagnostics enable manufacturers to achieve higher productivity while maintaining complete process transparency.

Digitalisation also improves plant reliability by allowing operators to identify process deviations before they develop into production issues. Remote monitoring capabilities enable faster troubleshooting and technical support, helping customers minimise downtime and optimise plant availability.

As the industry moves towards Industry 4.0, predictive maintenance and data-driven process optimisation will become increasingly important. HRS continues to develop solutions that support greater connectivity, allowing customers to use operational data to improve equipment reliability, optimise maintenance schedules and enhance overall production efficiency.

In a competitive processing equipment market, what differentiates HRS Process Systems from other solution providers, and how do you continue to deliver value through innovation and customer-centric engineering?

The food processing industry is becoming increasingly competitive, and customers today expect far more than high-quality equipment. They are looking for technology partners who understand their business, appreciate the unique characteristics of their products and can deliver solutions that create measurable long-term value. This customer-centric approach has always been one of the defining strengths of HRS Process Systems.

Our greatest differentiator lies in our ability to combine global engineering expertise with deep application knowledge across a broad spectrum of food processing industries. Rather than offering standard equipment, we engineer customised process solutions that are tailored to each customer's production requirements, quality objectives and future growth plans. Whether it is a single processing module or a fully integrated turnkey facility, our focus remains on delivering reliable, efficient and future-ready solutions. Innovation is equally central to our business philosophy. We continuously invest in new technologies

that improve process performance, enhance product quality and simplify plant operations. This includes advancements in heat transfer, hygienic process design, intelligent automation, aseptic technologies and high-efficiency evaporation systems.

Beyond technology, we believe lasting customer relationships are built through responsive technical support, application expertise and long-term partnership. Our objective is not simply to supply equipment, but to help customers continuously improve the performance and competitiveness of their manufacturing operations.

Looking ahead, what key trends do you expect to shape the future of thermal processing and food manufacturing over the next few years, and how is HRS preparing to address these emerging opportunities?

The food processing industry is entering an exciting phase of transformation, driven by changing consumer expectations, rapid technological advancements and an increasing emphasis on sustainability. Over the coming years, I believe we will see greater investment in intelligent manufacturing, digital process control, resource-efficient production and flexible processing systems capable of responding quickly to evolving market demands.

Consumers are increasingly seeking products that retain their natural taste, nutritional value and freshness, which places greater emphasis on gentle thermal processing technologies. At the same time, manufacturers must improve operational efficiency while reducing energy consumption, water usage and overall environmental impact. These objectives will continue to influence technology investment decisions across the industry.

At HRS Process Systems, our strategy is closely aligned with these industry trends. We continue to invest in advanced thermal processing technologies, intelligent automation, hygienic engineering, digital connectivity and complete turnkey process solutions that enable customers to build highly efficient and future-ready manufacturing facilities.

As we look ahead, our focus will remain on combining engineering excellence, customer collaboration and continuous innovation to develop processing technologies that not only address today's manufacturing challenges but also anticipate the evolving needs of the food industry for years to come.

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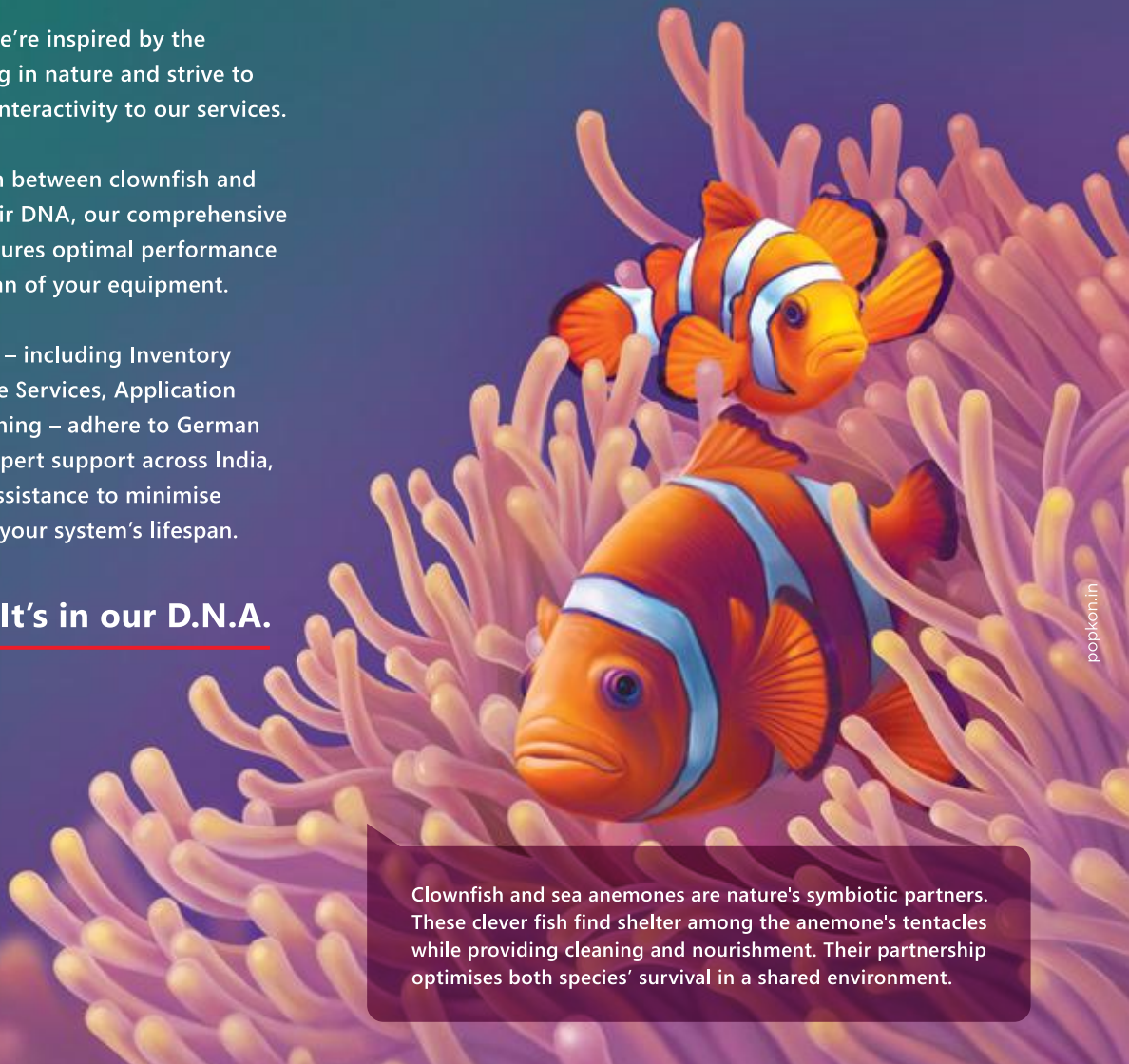
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Why India's Food Processing Industry Must Embrace Manufacturing Transformation Now



Reliability: Automated filling, weighing, and sealing lines eliminate variability that manual operations inevitably introduce. We have made significant investment in automated packaging lines for our Bail Kolhu and Nourish brand portfolios. This has delivered measurable improvements in fill accuracy, reduced material wastage, and improved shelf-life outcomes. This has worked because the process is consistent in every cycle, not merely most cycles.

Machine Intelligence: The price of machine vision systems, inline checkweighers, and automated foreign material detection have come down significantly making them accessible for mid-tier processors. The industry has fundamentally shifted from being an end-of-line quality control to continuous in-process monitoring. This is a change in philosophy, which has resulted in catching defects as they emerge rather than after the damage is done. A single quality incident can undo years of brand equity in a category like edible oils or dairy. Here, investment in technology is an investment in brand protection.

Data: Data remains the king and it is true to this category as well. Every minute, millions of data are being produced through rates, rejection frequencies, machine utilisation, energy consumption. The processing units that are learning to read and act on this data are building a compounding advantage. Operational data is now the foundation for predictive maintenance, demand-linked production scheduling, and yield optimisation. This is where the real transformation dividend begins to compound.

Where is Human Capital?

Amidst the massive automation that is taking place in the category, one question that I have often been asked is 'Will automation displace the workforce?' The right and the most appropriate question should be "What kind of workforce will get transformed?"

Industry data suggests that the industry employs an estimated 18 million people in India, and government targets under PLI schemes and the National Food Processing Policy envision significant expansion of that number. Automation does not reduce the that ambition but it does reshape it. The labour requirement shifts from repetitive manual tasks to machine operation, quality supervision, maintenance technician roles, and data interpretation functions.



Ashish Khandelwal,
Managing Director, BL Agro

India's food and beverages processing sector is at an inflection point. It remains one of the world's largest by volume but one question we need to ask ourselves is whether it is sustainable. Are we building the ecosystem for the next decade?

Over the last three decades, we have witnessed the food processing industry evolve from being a predominantly unorganised, fragmented operations into a maturing market where quality, speed, and scale are competitive necessities. Now we are entering one of the most important phases that will define the future. This will be defined not just by what we make, but by how we make it.

In today's world, transformation in manufacturing and automation are no longer priorities for multinationals or large conglomerates. It is the existential imperative for them and for every serious player in India's food and beverages processing ecosystem.

Where We Are

According to industry estimates, the country's packaged food market is projected to touch \$70 billion by 2025, growing at a CAGR of over

8 percent. This has been accelerated by the rise of e-commerce grocery channels, quick commerce platforms, and modern trade. There has been a rising demand for product consistency and the pressure on supply chain responsiveness. A customer ordering refined mustard oil or fortified flour at 11 pm and expecting doorstep delivery by 7 am is now a reality. This demand signal travels upstream, all the way to the factory floor.

However, when we peep into the industry, the reality is that a significant portion of our food processing capacity, particularly in mid-sized and regional enterprises, still operates on processes designed for a different era. The reality is that the industry ails from manual sorting, inconsistent filling and sealing, dependence on seasonal labour, reactive quality checks rather than continuous monitoring; these are realities that persist even as consumer expectations have leapfrogged dramatically.

Meanwhile, we are also seeing that compliance demand is rising. FSSAI's tightening of quality and traceability norms, BIS standardisation mandates, and increasing export compliance requirements from markets like the UAE, US, and EU mean that quality is no longer a differentiator, it is the entry ticket. The processing sector cannot absorb all these pressures with yesterday's infrastructure.

The Automation Dividend: What It Actually Means

There is a three-layer approach to automation in Indian food processing industry. It begins with targeted interventions and builds progressively toward integrated, intelligent manufacturing. There three layers are:

From our experience, I can say that just scaling operations and modernising manufacturing footprint is not enough. You have to invest in parallel skilling, training of plant staff on new equipment, cross-training for multiple roles, and creating internal pathways for workers to move into supervisory and technical positions. This an operations strategy because a workforce that understands and owns the technology performs better than one that is merely supervised by it.

The industry needs to engage more seriously with ITIs, food technology institutes, and skilling platforms to build a pipeline of manufacturing talent that is automation-ready. The PLI scheme for food processing is an opportunity not just for capacity investment but for a parallel investment in human capital upgrading.

Infrastructure and Policy Ecosystem need to come together

Manufacturing transformation cannot happen in a vacuum. It requires an environment that would enable this transformation. The best part is that the government's focus on food processing through the PLI scheme has catalysed genuine investment. Mega Food Parks and Integrated Cold Chain infrastructure projects are reducing the post-harvest loss problem that has long constrained the sector's economics. GST rationalisation, while still a work in progress, has improved the ease of inter-state trade for processed food companies.

However, there are frictions that the industry must collectively resolve. Industrial power tariffs in key manufacturing states remain high. This is big challenge in energy-intensive operations like cold storage, spray drying, and continuous cooking lines more expensive to run than they should be. Credit access for mid-tier food processors upgrading their facilities is also a challenge. Banks and NBFCs still tend to view manufacturing technology investment with more caution than warranted. Also, there is a huge challenge in importing automation equipment. The food processing industry needs a unified voice with policymakers on these operational realities. But the narrative must move beyond tax asks toward systemic enablers for technology adoption.

India's food processing sector has the raw material advantage, the domestic consumption depth, the government attention, and the entrepreneurial energy to be a global manufacturing force in processed food. What it needs now is the operational rigour that modern manufacturing transformation delivers. The factory floor of tomorrow is not a threat to India's food processing story. It is, in fact, the next chapter of it. And the time to start writing that chapter is now.

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Biosensors Transforming Food Safety: The Smart Technology Driving a Safer Global Food Supply Chain

The global food industry is undergoing a profound transformation as food safety becomes an increasingly critical concern for governments, manufacturers, retailers, and consumers alike. With food supply chains becoming more complex and globalized, ensuring the safety and quality of food products has never been more challenging. In response to these challenges, biosensor technology is emerging as one of the most powerful tools in modern food safety management.

According to Growth Market Report, the global biosensors for food safety market was valued at USD 6.1 billion in 2024 and is projected to reach USD 12.3 billion by 2033, expanding at a robust CAGR of 8.4% during the forecast period. This remarkable growth reflects the increasing adoption of advanced biosensing technologies across the food industry, driven by rising concerns over foodborne illnesses, stricter regulatory requirements, and growing demand for rapid, real-time testing solutions.

The Growing Need for Advanced Food Safety Solutions

Food safety has traditionally relied on laboratory-based testing methods that often require specialized equipment, trained personnel, and significant processing time. While these methods remain effective, they can be slow and costly, creating challenges for industries that require immediate decision-making. As consumer awareness regarding food quality and safety continues to increase, food manufacturers are under growing pressure to identify contaminants quickly and accurately. The rising incidence of foodborne diseases, combined with expanding global food trade and stricter regulatory oversight, has accelerated the demand for innovative technologies capable of providing faster and more reliable results.

Biosensors are addressing this need by enabling real-time monitoring and rapid detection of harmful substances throughout the food supply chain.

Understanding Biosensors and Their Importance

A biosensor is an analytical device that combines a biological recognition element with a physicochemical detector to identify and measure specific substances. These devices can detect pathogens, toxins, pesticides, allergens, heavy metals, and other contaminants that may compromise food quality and consumer safety.

Unlike conventional laboratory testing methods, biosensors offer several distinct advantages:

- Rapid and real-time detection
- High sensitivity and specificity
- Portable and user-friendly operation
- Reduced reliance on centralized laboratory infrastructure
- Cost-effective testing capabilities

These benefits make biosensors particularly valuable for emerging economies such as India, where decentralized testing solutions can significantly enhance food safety monitoring across diverse agricultural and food processing sectors.

Market Growth Driven by Consumer Awareness and Regulatory Pressure

The global biosensors for food safety market is witnessing substantial growth as food safety concerns continue to intensify worldwide. Several factors are contributing to the market's expansion.

One of the primary growth drivers is the increasing prevalence of foodborne illnesses. Contaminated food products can lead to serious health consequences, prompting governments and regulatory bodies to enforce stricter quality standards throughout the food production process. The growing demand for packaged, processed, and ready-to-eat foods is also fueling the need for advanced safety testing technologies. As food products travel through longer supply chains and multiple distribution channels, maintaining consistent quality becomes in-

creasingly important. In addition, technological advancements in biotechnology, nanotechnology, and digital monitoring systems are improving biosensor performance, making these devices faster, more accurate, and more accessible than ever before.

For India, the rapid growth of the food processing sector, combined with increased emphasis on food quality standards, positions the country as an important contributor to the future expansion of the biosensors market.

Key Growth Drivers

- Rising incidence of foodborne illnesses worldwide
- Growing demand for packaged and processed food
- Expansion of global food trade
- Government regulations enforcing stringent quality checks
- Technological advancements in nanotechnology and biotechnology

Types of Biosensors Revolutionizing Food Testing

Different biosensor technologies are being utilized across the food industry, each designed to detect specific contaminants and quality indicators.

Optical Biosensors

Optical biosensors detect changes in light properties when biological interactions occur. These systems are widely used for identifying pathogens, toxins, and microbial contamination in food products. Their high accuracy and rapid response times make them particularly effective for quality assurance applications.

Electrochemical Biosensors

Among the most widely adopted biosensor technologies, electrochemical biosensors measure electrical signals generated by biochemical reactions. They are highly sensitive, cost-effective, and suitable for detecting

pesticide residues, heavy metals, and various chemical contaminants.

Piezoelectric Biosensors

Piezoelectric biosensors monitor changes in mass on a sensor surface. These devices are particularly effective in detecting microbial contamination and are increasingly being integrated into food quality monitoring systems.

Thermal Biosensors

Thermal biosensors measure temperature changes associated with biochemical reactions. Frequently used in enzyme-based detection systems, they provide valuable insights into food composition and contamination levels.

Applications Across the Food Supply Chain

The versatility of biosensors enables their use across virtually every stage of the food supply chain, from agricultural production to retail distribution.

Agriculture and Raw Material Testing: In agriculture, biosensors assist farmers in detecting pesticide residues, soil contaminants, and environmental pollutants before harvest. Early identification of these issues helps improve crop quality and reduces potential food safety risks.

Food Processing Units: Food manufacturers are increasingly incorporating biosensors into production facilities to monitor microbial contamination and verify compliance with food safety standards. Real-time detection allows immediate corrective action, minimizing product recalls and reducing waste.

Packaging and Storage: One of the most exciting developments in the industry is the integration of biosensors into smart packaging systems. These intelligent packages can detect spoilage, monitor freshness, and provide valuable information regarding product quality throughout storage and transportation. By identifying changes in food conditions before products deteriorate, biosensor-enabled packaging can help extend shelf life and reduce food waste.

Retail and Distribution: Portable biosensors enable rapid quality checks during transportation, warehousing, and retail operations. This capability helps prevent contaminated products from reaching consumers while improving overall supply chain transparency.

India's Expanding Role in the Biosensors Market

India is emerging as a significant player in the global biosensors for food safety market due to several strategic advantages. The country's

strong agricultural foundation, expanding food processing industry, and increasing adoption of digital technologies create a favorable environment for biosensor deployment. Government initiatives aimed at improving food quality standards and strengthening food safety regulations are further encouraging technology adoption.

Additionally, Indian research institutions and technology startups are actively developing affordable biosensor solutions tailored to local requirements. These innovations have the potential to enhance food safety not only within India but also across international markets seeking cost-effective testing technologies.

Technological Innovations Accelerating Market Growth

Continuous technological advancements are significantly enhancing the capabilities of biosensors and expanding their applications within the food industry.

Nanotechnology-Enhanced Biosensors : The integration of nanomaterials is improving sensor sensitivity, enabling detection of contaminants at extremely low concentrations. These advanced materials also contribute to faster response times and improved reliability.

AI and IoT Integration: Artificial Intelligence (AI) and the Internet of Things (IoT) are transforming biosensors into intelligent monitoring systems. Connected sensors can continuously collect data, provide real-time alerts, and support predictive analysis for proactive food safety management.

Lab-on-a-Chip Technologies: Miniaturized lab-on-a-chip devices are revolutionizing food testing by performing complex analyses within compact and portable platforms. These systems offer laboratory-level accuracy while significantly reducing testing time and operational costs.

Smartphone-Based Detection Systems: The emergence of smartphone-integrated biosensors is making food safety testing more accessible, particularly in remote and underserved regions. Mobile-based platforms enable users to conduct tests and receive results instantly, enhancing food safety surveillance at multiple levels.

Challenges Facing the Industry

Despite strong growth prospects, the biosensors for food safety market faces several challenges that must be addressed to achieve widespread adoption. High development and implementation costs remain a significant barrier, particularly for smaller food producers and developing markets. In addition, the lack

of standardized regulations and testing protocols across different regions can complicate commercialization efforts.

Limited awareness regarding biosensor capabilities, coupled with technical complexities associated with large-scale deployment, also presents obstacles to market expansion. Addressing these challenges will require collaboration among governments, regulatory agencies, industry stakeholders, technology providers, and research institutions.

Competitive Landscape

The biosensors for food safety market is highly competitive and features participation from leading global technology, diagnostics, and life science companies. Key players include Bio-Rad Laboratories, Thermo Fisher Scientific, Siemens Healthineers, F. Hoffmann-La Roche, Honeywell International, DuPont, Neogen Corporation, Agilent Technologies, Randox Laboratories, Mettler Toledo International, PerkinElmer, 3M Company, Sartorius AG, Bayer AG, Yokogawa Electric Corporation, R-Biopharm AG, Nova Biomedical Corporation, Biosensor Applications Sweden AB, Biacore (Cytiva), and BenQ Materials Corporation. These companies continue to invest heavily in research and development to improve sensor performance, expand product portfolios, and strengthen their positions in the rapidly growing food safety technology market.

Future Outlook: Building a Smarter and Safer Food Ecosystem

The future of the biosensors for food safety market appears exceptionally promising. As food manufacturers seek faster, more accurate, and cost-effective testing solutions, biosensors are expected to become an integral component of food safety management systems worldwide.

Several trends are expected to shape the next phase of market development, including the increasing adoption of real-time monitoring platforms, wider deployment of smart packaging technologies, integration with blockchain-based supply chain systems for enhanced traceability, and the emergence of personalized food safety testing solutions.

As technological innovation continues to advance and regulatory support strengthens globally, biosensors will play a pivotal role in creating a safer, more transparent, and more resilient food ecosystem. For the food industry, these intelligent sensing technologies represent not only a tool for compliance but also a strategic investment in consumer trust, operational efficiency, and long-term sustainability.

Growthmarketreports



Smart Climate Monitoring Made Easy: The New Online Data Loggers From Testo

Ensuring product safety and regulatory compliance has never been more efficient, thanks to the latest range of online data loggers from Testo. Designed to simplify operations, these advanced solutions eliminate manual monitoring by seamlessly connecting to the testo Saveris Cloud—automating data collection, alerts, and documentation. This enables businesses in the food and pharmaceutical sectors to focus more on their core operations while maintaining the highest quality standards.

In industries where strict regulations, time constraints, rising costs, and workforce challenges are everyday realities, Testo's new generation of data loggers—testo 160, testo 162, and testo 164—offer a dependable and efficient monitoring solution. These devices streamline the entire process, reducing workload while enhancing operational reliability.

Automated processes through cloud and app connection

The entire monitoring system consists of the testo Saveris Cloud, the connected loggers and the testo Smart App. And this is how it works: The measurement data is automatically and completely recorded and documented in the cloud, where it can be accessed and analyzed at any time and from anywhere – via mobile phone, tablet or PC. The payable Testo Data Monitoring Licence is required to use the system.

In the associated testo Smart App, users also have access to the cloud, including all measurement data. In addition, the data loggers are especially easy to configure via the app. If a limit value is exceeded, an alarm is triggered immediately – those responsible receive it by e-mail or push notification.

The automation makes time-consuming manual processes a thing of the past. With minimal effort, users have 100% control over the safety of their products.

Reliable, efficient and flexible

The online data loggers are available in a total of twelve product variants. There is a suitable solution for every application. The various data loggers can also be combined with each other and integrated in the cloud.

- **testo 160: Automatic monitoring of temperature, humidity, lux and UV**

This online data logger has an unobtrusive design and is one of the more affordable data loggers. It's available in three versions: testo 160 T with integrated temperature sensor, testo 160 TH with integrated temperature and humidity sensor and testo 160 E with connection option for two external sensors (temperature, humidity, lux and UV).

- **testo 162: Automatic monitoring of temperature, humidity, pressure and CO₂**

The online data logger with HACCP certification features a display for checking the readings. It's available in seven versions: with integrated probes, with external connection options, for NTC or TC probes, for measuring temperature, humidity, pressure and CO₂.

- **testo 164: Automatic monitoring of temperature and relative humidity**

A mini online data logger with an unobtrusive design and many advantages: It can also be used where there is no WLAN, has a battery life of eight years and is HACCP and NSF-certified. The data logger is connected to the gateway at the touch of a button. The mini data logger is available in three versions as well as two gateway options with WLAN or Ethernet connection.

- **testo 104-IR BT – Smart temperature control for food safety**

The testo 104-IR BT combines infrared surface measurement and penetration core temperature measurement in one compact instrument, making it the ideal solution for fast and reliable temperature checks in the food industry. Designed for demanding HACCP environ-

ments, it helps users monitor critical control points (CP/CCP) with confidence and accuracy.

With Bluetooth connectivity and the testo Smart App, all measurement data can be transferred automatically for seamless digital documentation, ensuring compliance with regulatory requirements and supporting internal quality assurance processes. Measurements can also be performed independently of the app, offering maximum flexibility in daily operations.

The fold-out penetration probe activates the instrument instantly, while a single button starts the infrared measurement. Its large, easy-to-read display, intuitive controls, and IP65 waterproof protection make it especially practical for busy food production, catering, and inspection environments.

The testo 104-IR BT delivers a perfect combination of speed, precision, and smart documentation, helping food professionals maintain product quality and food safety with greater efficiency.

About Testo India

Established in 2006, Testo India Pvt. Ltd. is a 100% subsidiary of Testo SE & Co KGaA, which is a world leader in design, development and manufacturing of electronic portable test and measuring instruments. Testo India has shown phenomenal growth over the past 20 years with new products and innovations getting added to the basket year after year. We have extended our reach throughout the nation, increasing our support and services in every aspect. The head office is located at Pune with a PAN India sales and channel partner network.

Testo also has an established state-of-the-art NABL accredited service & calibration LAB in accordance with the standard ISO/IEC 17025 : 2017, that takes care of the after sales support. Testo service & calibration facility is highly cost effective as it delivers international standards very conveniently locally from Pune. Instruments of any brand/make can be calibrated and serviced locally maintaining necessary standards.

For more details, login to our website
www.testo.com or
write back to us on info@testo.in

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Aseptic Beverage Processing: Opportunities in Emerging Markets



In today's date, the beverage industry is evolving at a significant rate. The Indian beverage industry is witnessing a rapid growth in organized beverage manufacturing as consumers increasingly embrace ready-to-drink (RTD), functional, and premium beverage categories.

Aseptic processing is becoming more important for the growth of the beverage industry. It's helping companies make new products and meet the changing demands of the market. With aseptic processing, companies can make a wide range of drinks that are safe, healthy, and taste good. This is an exciting time for the beverage industry, and aseptic processing is playing a big role in its future.

Changing Consumer Preferences are Reshaping the Beverage Market

Consumer preferences have evolved considerably over the past decade. Modern consumers are more informed about nutrition, ingredient quality, and product safety than ever before. At the same time, busy lifestyles have increased the demand for convenient beverage options that can be consumed on the go.

This shift has accelerated the growth of ready-to-drink (RTD) beverage categories across emerging markets. Products such as RTD tea, RTD coffee, flavored dairy beverages, sports drinks, and nutritional beverages are gaining popularity among consumers looking for convenient alternatives to traditional beverage formats.

Beverages that don't need to be kept cold or can't be stored for long are a problem. But

Premium beverages often incorporate complex formulations, specialized ingredients, and differentiated processing requirements. Consistency becomes a key factor, as consumers expect every pack to deliver the same taste, texture, and quality regardless of when or where it is purchased. Advanced aseptic processing systems help processors achieve the level of process control required for premium beverage production. By maintaining consistent processing conditions and ensuring product safety, processors can strengthen brand reputation and support long-term market growth.

some drinks can be stored for a long time without going bad. To keep these drinks good and safe, companies are using new and better ways of making them. This helps the drinks stay good even when they are stored and sent to stores. It also helps companies make more drinks without hurting the quality. Aseptic processing provides a reliable solution by enabling beverages to be sterilized and packaged under controlled hygienic conditions, helping manufacturers deliver products that meet consumer expectations for quality, safety, and convenience.

Health and Wellness Trends are Reshaping Beverage Innovation

One of the most influential trends driving the beverage industry today is the growing focus on health and wellness. Consumers are actively seeking products that offer functional benefits beyond basic hydration. The demand for protein-enriched beverages, fortified drinks, immunity-supporting formulations,

low-sugar beverages, and plant-based alternatives continues to grow across multiple consumer demographics. Younger consumers, fitness-conscious individuals, and health-focused households are increasingly incorporating these products into their daily routines.

Making these kinds of drinks can be tough because they need special care when being processed. Lots of the good stuff in them can get damaged easily if not handled just right, which means they might not be as healthy or taste as good. So, it's really important to make sure the drinks are safe to drink while still keeping all the good things about them, like how they taste and feel, and all the nutrients they have. This is key to making a product that people will want to buy and drink.

Aseptic processing offers beverage processors the ability to achieve microbiological safety while minimizing the impact on product quality. This allows manufacturers to develop innovative formulations that meet evolving consumer demands without compromising product performance.

Premiumization is Driving Higher Quality Standards

Another important trend shaping emerging beverage markets is premiumization. Consumers are no longer evaluating beverages solely on the basis of price. Surprisingly, purchasing decisions are influenced by perceived quality, nutritional value, ingredient transparency, and overall product experience. This trend is encouraging beverage manufacturers to introduce premium offerings across various categories. Whether it is a high-protein dairy beverage, a cold-brew coffee, a plant-based drink, or a specialized nutritional formulation, consumers are willing to pay more for products that deliver superior value.

Premium beverages often incorporate complex formulations, specialized ingredients, and differentiated processing requirements. Consistency becomes a key factor, as consumers expect every pack to deliver the same taste, texture, and quality regardless of when or where it is purchased.

Advanced aseptic processing systems help processors achieve the level of process control required for premium beverage production. By maintaining consistent processing conditions and ensuring product safety, processors can strengthen brand reputation and support long-term market growth. For beverage companies looking to differentiate themselves in increasingly competitive markets, aseptic processing can serve as a strategic enabler of product innovation and premium positioning.



The Shift Toward Modern Beverage Manufacturing

The beverage industry in emerging markets is also experiencing a broader shift toward modernization. This shift is increasingly embracing automation, hygienic design, and data-driven manufacturing practices. Modern processing facilities are focusing on improving operational efficiency, enhancing product safety, and ensuring compliance with increasingly stringent quality standards.

In this environment, investments in UHT systems, aseptic storage solutions, automated process controls, and integrated production lines aligns well with the industry needs. Beverage processors are recognizing that sustainable growth requires not only innovative products but also robust manufacturing infrastructure capable of delivering consistent performance.

Process equipment manufacturing companies like Neologic Engineers offer aseptic processing technology that supports high levels of process control, minimizes contamination risks, and facilitates the production of a wide range of beverage products. All of this while maintaining strict hygiene and quality standards. This makes it an attractive solution for beverage processors looking to remain competitive in a dynamic marketplace.

Export Potential and Global Market Access

Emerging markets are increasingly positioning themselves as manufacturing hubs for value-added beverage products. As Indian beverage brands continue to strengthen their presence in international markets, the need for globally competitive processing technologies has become increasingly important.

Shelf life, microbiological safety, and product consistency are essential considerations for beverages intended for international markets. Aseptic processing helps manufacturers address these requirements by enabling the production of stable, high-quality beverages suitable for long-distance distribution and export.

International markets demand high levels of product consistency, safety, and reliability. Beverages intended for export often face extended transportation timelines and diverse storage conditions before reaching consumers. These factors place significant importance on product stability and shelf life.

By reducing quality risks and enhancing product reliability, aseptic processing can help beverage companies strengthen their export capabilities and explore new growth opportunities beyond domestic markets. Aseptic processing enables manufacturers to produce beverages that can withstand longer distribution cycles while maintaining their quality attributes. This capability is particularly valuable for categories such as nutritional beverages, functional drinks, dairy beverages, and plant-based products.

Looking Ahead

The way people buy drinks is changing in new markets. More people are thinking about their health and wanting better products. They also want things that are easy to get and use. To be successful, companies that make drinks need to come up with new ideas, keep people safe, and make sure their products are good. These changes are giving companies a chance to make new products and sell to more people. They have to balance making new things with making sure everything is safe and works well.

EXHIBITIONS & CONFERENCES 2026-2027

Foodpro - 2026
7 - 9, Aug - 2026
Chennai Trade Centre

DairyTech India - 2026
India Foodex - 2026
21 - 23, Aug - 2026
KTPO, Bangalore

Fi India - 2026
26 - 28, August - 2026
Bombay Exhibition Centre, Mumbai

ProPak India - 2026
26 - 28, August - 2026
Bombay Exhibition Centre, Mumbai

Anuga FoodTec India - 2026
29 Sep - 1 Oct - 2026
Bombay Exhibition Centre, Mumbai

Anuga Select India - 2026
29 Sep - 1 Oct - 2026
Bombay Exhibition Centre, Mumbai

drinktec India - 2026
28 - 30, Oct - 2026
Bombay Exhibition Centre, Mumbai

PackMach Asia Expo - 2026
28 - 30, Oct - 2026
Bombay Exhibition Centre, Mumbai

Refcold India - 2026
19 - 21, Nov - 2026
Agriculture College Ground, Pune

World SnackPro Expo - 2026
3 - 5, Dec - 2026
Ludhiana Exhibition Centre, Punjab

Annappurna Inter Food - 2026
9 - 11, Dec - 2026
Bombay Exhibition Centre, Mumbai

Inter FoodTech - 2027
15 - 17, April - 2027
Bombay Exhibition Centre, Mumbai



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www.foodnbeveragesprocessing.com

www.neologicengineers.com/aseptic-storage-system-manufacturers

End-of-line Automation and Palletizing Solutions



**Tom Rosier, Sales Director,
Verbruggen Palletizing Solutions**



Verbruggen Palletizing Solutions has introduced a new, internationally aligned naming structure for its complete machine portfolio. The familiar VPM model names are being replaced by a clear and scalable V-series, including names such as V-Stack, V-Wrap and V-Pack.

The new naming strategy supports Verbruggen's ambition to strengthen its global brand while making its palletizing and packaging solutions easier to understand for customers worldwide. Sales Director Tom Rosier explains the thinking behind this strategic step.

A portfolio reviewed through a commercial lens

Revising the naming of the Verbruggen machine range was not without reason. According to Rosier, the initiative started with a different way of looking at the company's product portfolio. "The main trigger was that we decided to review our portfolio from a commercial perspective rather than purely from an engineering perspective," he explains. "We analyzed how our palletizers and packaging machines are positioned in the market and how customers experience our product range."

That exercise led to several key questions. Are the product names internationally understandable? Are they scalable for future expansion? And do they clearly communicate the function of each machine? "From that

strategic exercise, the new V-series naming structure was developed," Rosier says.

Names that immediately communicate what a machine does

One of the most important goals was clarity. The new names are designed to immediately express the main activity of each machine. "If a machine stacks products, the name should reflect that. That's why our palletizers are now called V-Stack," Rosier explains. "Machines that wrap pallets fall under V-Wrap, and packing solutions are named V-Pack."

In addition to describing the function, the naming structure also provides insight into the machine's capacity and configuration. "The numbering helps customers quickly understand what type of machine they are looking at and the performance level they can expect. Whether it concerns a bag palletizer or a box palletizer, the name already tells part of the story."

A structured and scalable naming system

The new naming follows a clear format:
V-Stack [three digits]

Within this structure, each element has a specific meaning:

- Even numbers indicate bag palletizers
- Odd numbers indicate box palletizers
- The last two digits represent the minimum output capacity in bags or boxes per minute

For example, the V-Stack 745 refers to a box palletizer with a minimum capacity of 45 boxes per minute. This model replaces the previously known VPM-BXL.

Rosier compares the logic behind the naming to the automotive industry. "You could compare it to how car manufacturers structure their model ranges. Think of a series where each number indicates a higher performance level. With one strong platform you can offer multiple executions. That is exactly how our modular palletizing solutions work."

Built for growth and international markets The new naming structure also aligns with Verbruggen's long-term strategy. As the company continues to expand its palletizing and packaging solutions, the product portfolio must remain clear and scalable. "In the future we will offer even broader and more integrated solutions," Rosier explains. "This naming strategy allows us to expand product groups and introduce new machine types in a structured and consistent way."

Another important factor is international usability. "The names are short, recognizable and easy to pronounce in multiple languages. That makes it easier for customers and distributors worldwide to understand our machines."

Developed through cross-functional collaboration

The naming strategy was developed through



a collaborative process involving several departments within Verbruggen. "We started with a working group including marketing, engineering, sales and product management," Rosier says. "We conducted market research, analyzed competitors and combined those insights with our internal expertise." The final naming structure received full support across the organization. "It was important that R&D, Sales and the Management Board all supported the outcome. This is not just a marketing change – it is a strategic brand decision."

Clearer for customers, more logical for partners

For customers, the change mainly results in clearer and more intuitive product names. "The machines themselves remain the same reliable Verbruggen palletizers customers know and trust," Rosier explains. "What changes is that the names are now easier to connect to what the machine actually does." For distributors and sales teams, the benefits are even greater. "The product range has become more logical. When you see a machine name, you immediately understand where it fits in the portfolio and what type of application it is designed for."

Strengthening the Verbruggen brand

According to Rosier, the new naming strategy also reinforces the Verbruggen brand in the global palletizing market. "We want customers to choose a strong and reliable brand. Verbruggen has been a trusted name in palletizing solutions for decades." At the same time, the company continues to evolve. "This new naming structure shows that we are aware of market developments and continuously improving how we present our solutions.

It strengthens our identity as a future-oriented brand."

A foundation for future machine developments

Looking ahead, Rosier sees the new structure as the foundation for further development of the Verbruggen machine portfolio. "This system gives us the flexibility to introduce new machines, configurations and product groups while keeping the portfolio clear and consistent."

Recognition, connection and trust

Ultimately, Rosier hopes the new naming will strengthen the connection between Verbruggen and its customers. "I hope customers immediately recognize that these machines belong to a brand with a clear vision and a well-thought-out identity," he says. "If I had to summarize the new naming strategy in one sentence, it would be about recognition and connection. By recognizing what customers need, we can present a product portfolio that is logical, transparent and aligned with those needs."

A future-proof Verbruggen

With the introduction of V-Stack, V-Wrap, V-Pack, V-Load and V-Weigh, Verbruggen Palletizing Solutions takes an important step toward a clearer and stronger global machine portfolio. The new naming will be introduced gradually across machines, the website, brochures, quotations and internal systems. As Rosier concludes: "We are here to stay. We continue to evolve, but our reliability remains unchanged.

"Customers can continue to build on Verbruggen — today and in the future."

Tom Rosier – Sales Director at Verbruggen Palletizing Solutions

www.verbruggen-palletizing.com

Moisture Control: The Key to Quality in India's Food & Beverage Industry



India's food and beverage industry is one of the most dynamic and rapidly expanding sectors in the country, valued at over USD 300 billion and growing steadily year on year. With demand surging across processed foods, beverages, frozen goods, and packaged products, maintaining product quality, freshness, and safety has become a top priority for manufacturers across the supply chain.

However, one critical yet often overlooked threat to product integrity is moisture. In the presence of excess humidity, food products tend to undergo microbial spoilage, oxidation, and physical breakdown. Items such as chocolates, candies, cereals, instant coffee, and spices are particularly vulnerable — absorbing moisture from the atmosphere and gradually losing their texture, taste, aroma, and shelf life.

The challenge extends across every stage of production — from raw material storage and processing to packaging and distribution. For export-oriented products such as mushrooms, apples, mangoes, and seafood, maintaining precise humidity levels during storage and transit is absolutely critical to meet international food safety and quality benchmarks.

Advanced dehumidification technology offers a highly effective solution to this challenge. By maintaining consistent relative humidity (RH) levels throughout production and storage environments, dehumidifiers prevent microbial growth, preserve product palatability, and significantly extend shelf life. Companies like Bry-Air have developed specialised, energy-efficient desiccant dehumidification systems tailored specifically for the food and beverage sector, helping manufacturers meet stringent global quality standards.

As India strengthens its position as a significant food exporter on the world stage, adopting reliable moisture control solutions will be essential to delivering fresh, safe, and high-quality products to consumers worldwide.

www.bryair.com



Building Trust in the Premium Food Segment through Quality, Authenticity, and Sourcing



Aman Uppal, Business Head, Savore

In today's food landscape, consumers are no longer making purchasing decisions based solely on taste or price. They want to know where their food comes from, how it is made, who produces it, and whether the promises on the packaging genuinely reflect the product inside. This shift is particularly evident in the premium food segment, where trust has become one of the most valuable ingredients of all. Premium food brands are expected to deliver more than superior products; they are expected to uphold transparency, consistency, and integrity at every stage of the value chain. As consumer awareness grows, building trust is no longer a marketing advantage, it is a business imperative.

Quality as the Foundation of Trust

Quality remains the cornerstone of any successful premium food brand. Consumers who choose premium products are investing in an experience and expect a certain standard in return. This means maintaining consistency across every batch, ensuring rigorous quality control, and adhering to the highest food safety standards. However, quality today extends beyond the final product. It encompasses the entire journey from ingredient selection and production processes to packaging and storage. Consumers are increasingly informed and can quickly identify falsifications between brand claims and actual experiences. A single lapse in quality can significantly impact consumer confidence, especially in a segment where expectations are inherently high.

For premium food brands, sustained trust is built through a relentless commitment to delivering excellence every single time.

Authenticity Matters More Than Ever Today

In an era of information overload, authenticity has become a key differentiator. Consumers are actively seeking brands that have a genuine story, a clear purpose, and a commitment to staying true to their values. Authenticity is not about creating an appealing narrative, it is about ensuring that every aspect of the brand aligns with reality. Whether it is a traditional recipe, a unique sourcing region, a family legacy, or a commitment to craftsmanship, consumers value honesty and transparency.

The rise of social media and digital platforms has also made it easier for consumers to research the claims of brands. They expect openness regarding ingredients, production methods, sustainability efforts, and business practices. Brands that communicate transparently and remain consistent in their messaging are far more likely to earn long-term loyalty. In contrast, exaggerated claims or misleading marketing can quickly erode credibility. Trust, once lost, is difficult to rebuild.

Responsible Sourcing Creates Meaningful Connections

Sourcing has emerged as one of the most influential factors shaping consumer perception in the premium food category. Today's consumers want assurance that the ingredients used in their products are not only of superior quality but are also sourced responsibly. Ethical sourcing practices help establish a deeper connection between brands and consumers. When customers understand where ingredients originate, how they are cultivated, and the impact of sourcing decisions on local communities and ecosystems, they are more likely to develop confidence in the brand.

This growing emphasis on traceability reflects a broader desire for accountability. Consumers appreciate brands that can provide visibility into their supply chains and demonstrate meaningful relationships with farmers, producers, and suppliers. Responsible sourcing is also closely linked to sustainability. As environmental concerns become increasingly important, consumers are seeking

brands that actively work to reduce waste, support regenerative agricultural practices, and make environmentally conscious choices throughout their operations.

Transparency Builds Long-Term Loyalty

Trust is not built through a single transaction, it is earned over time through consistent actions and transparent communication.

Premium food brands that honestly share information about their sourcing, quality standards, certifications, and manufacturing processes empower consumers to make informed choices. Transparency transforms customers into advocates because it reinforces confidence in every purchase. More importantly, transparency also means acknowledging challenges. Consumers understand that no business is perfect, what they value is honesty, accountability, and a willingness to continuously improve. Brands that communicate openly about their journey often cultivate stronger relationships than those that attempt to present an unrealistic image of perfection.

The Future of Premium Food is Rooted in Trust

As the premium food industry continues to evolve, trust will remain a defining factor in consumer decision-making. Quality, authenticity, and responsible sourcing are no longer optional buzz-words, they are the pillars upon which enduring brands are built. For consumers, premium products represent more than a purchase, they represent a choice to invest in products that align with their values and expectations. For brands, this presents both an opportunity and a responsibility.

The businesses that will thrive in the years ahead are those that prioritize transparency, maintain uncompromising quality standards, embrace authentic storytelling, and foster meaningful relationships across their supply chains.

At its core, trust is what transforms a customer into a loyal consumer and a product into a brand. In the premium food segment, it is the most valuable asset any company can cultivate and one that must be earned every day.

Domino Launches Gx-Series PRO to Enable Manufacturers Prepare for GS1 Sunrise and 2D Barcode Adoption

Domino India has announced the launch of the Gx-Series PRO, a next-generation thermal inkjet printhead designed to help Indian manufacturers prepare for the industry's transition to GS1 Sunrise standards and the growing adoption of 2D barcodes, including QR Codes and Data Matrix codes, across retail and supply chains.

As packaging requirements evolve worldwide, manufacturers are increasingly looking for coding solutions that support enhanced traceability, regulatory compliance, consumer engagement, and digital supply chain connectivity. The Gx-Series PRO has been engineered to meet these emerging needs by delivering high-quality, GS1-compliant 2D codes at production-line speeds without compromising operational efficiency.

Designed for manufacturers in the food, beverage, FMCG, pharmaceutical, and consumer goods sectors, the Gx-Series PRO combines exceptional print performance with operational flexibility, helping businesses stay ahead of changing industry standards while preparing their packaging operations for the future. Unlike conventional coding systems, the Gx-Series PRO delivers larger print areas, superior print contrast, and reliable code grading across both porous and non-porous substrates. With print resolutions of up to 1200 dpi and print speeds of up to 390 metres per minute, the solution enables manufacturers to produce high-quality variable data codes at scale. Support for up to four stitched printheads further expands printing capabilities, allowing larger print heights and greater coding flexibility across production lines.

The Gx-Series PRO is also engineered to perform reliably in demanding manufacturing environments. An optional printhead heater supports operation in chilled production areas, while Domino's food-packaging compliant inks, manufactured in accordance with EuPIA Good Manufacturing Practices, make the solution particularly well suited for food and beverage applications.

"The packaging industry is undergoing a significant transformation as manufacturers prepare for the next generation of product identification and digital connectivity," said Tanuj Agrawal, Managing Director, Domino Printech India. "At Domino, we are commit-

ted to bringing globally advanced technologies to our customers, enabling them to stay ahead of changing industry standards while improving operational efficiency, compliance, and long-term business growth. The launch of the Gx-Series PRO reinforces our commitment to supporting manufacturers with future-ready coding and marking solutions."

The increasing adoption of 2D codes is creating new opportunities for brands to improve traceability, strengthen supply chain visibility, support digital deposit return schemes, and enhance consumer interactions through connected packaging experiences.

"As 2D codes become increasingly important for product traceability, supply chain visibility, and consumer engagement, manufacturers need coding solutions that can consistently deliver high-quality results at scale," said Sachin Mall, Assistant Vice President – Products, Applications & Solutions, Domino



Printech India. "With its high-resolution printing capabilities, scalable printhead configurations, and dependable performance across a broad range of substrates, the Gx-Series PRO enables manufacturers to confidently meet evolving GS1 requirements while maintaining consistent code quality in demanding production environments."

The Gx-Series PRO is fully compatible with Domino's Gx150i, Gx350i, and GxOEM platforms, enabling manufacturers to seamlessly upgrade existing installations while benefiting from larger print heights and multiple print positions managed through a single controller. As Indian manufacturers prepare for the future of packaging, product identification, and digital traceability, the Gx-Series PRO delivers a scalable and future-ready solution to support the industry's transition to GS1-compliant 2D coding.

Dennis Group Highlights Integrated Packaging Solutions for Food and Beverage Manufacturers

Dennis Group, a design-build firm specializing in the food and beverage industry, offers integrated packaging system solutions that seamlessly connect primary and secondary packaging, palletizing, and warehousing into a unified framework to maximize throughput, flexibility, and long-term scalability. By integrating packaging, processing, and warehouse design from concept through start-up, the company helps manufacturers avoid bottlenecks, optimize line layouts, reduce change-order risks, and create operations that can adapt to changing product portfolios. Its solutions cover packaging lines for solids, liquids, powders, and semi-solids, ensuring efficient integration with material handling, palletizing, and warehouse logistics to improve labor utilization and production flow.

Dennis Group also leverages 2D/3D



modeling, physics-based simulations, and digital twin technology to validate system performance, optimize Overall Equipment Effectiveness (OEE), and accelerate commissioning before equipment installation. In addition, the company incorporates scalable electrical systems, automation, safety features, and machine retrofit options to support future expansion, enhance reliability, and maximize existing assets, delivering packaging operations that are efficient, compliant, and ready for future growth.

Checkweighing Strategies to Help Dairy Producers Reduce Giveaway and Protect Margins



Dairy production leaves very little room for uncertainty. A yoghurt cup that runs slightly heavy, a milk bottle that drifts above target weight, or a cream tub that is filled with too much margin may seem like a minor issue on the line. Across thousands of packs an hour, however, those small variations can become a significant drain on profitability and operational control.

For dairy manufacturers, the challenge is not simply to reduce waste in a general sense. It is to control high volume giveaway while meeting label weight compliance requirements, maintaining consistent pack presentation and keeping wet, high throughput production environments running smoothly. This is particularly important across lines producing milk, yoghurt, cream, desserts, butter, cheese portions, and dairy powders; where pack formats, product behaviour, and production speeds can vary considerably.

Traditional weight checks can show whether a sample is within tolerance at a certain moment, but they do not always give operators the visibility needed to understand

what is happening across the full production run. If a filling process begins to drift, or if product viscosity, foaming, temperature, or line conditions affect pack weight, the financial impact can build quickly before the issue is spotted.

This is where intelligent checkweighing has become an important part of modern dairy production. By inspecting every pack, capturing weight data continuously, and giving operators clearer insight into process performance, dynamic checkweighers can help producers reduce giveaway, support net content control, and act earlier when trends begin to move away from target.

The strongest results come from treating checkweighing as part of a wider production strategy, not just as a final inspection point. For dairy lines, this means combining five practical approaches: automation for consistent pack weights, smart weight verification, accurate product and portion control, regular maintenance and performance verification, and data-led continuous improvement. Together, these strategies can help dairy producers protect margins while building more stable, compliant, and efficient lines.

1. Automation for consistent dairy pack weights

Spot checks and manual sampling still have a place in many dairy plants, but they only provide a snapshot of line performance. A cup, tub or bottle may be compliant at the point of testing, while the wider production run is already beginning to drift. On fast moving lines, this delay can result in avoidable overfill,

underweight rejects, or additional rework. Intelligent checkweighers support 100% inline weight inspection, checking every finished pack as it passes across the line. Underweight packs can be automatically rejected before they reach distribution, while weight data is captured continuously to show how closely production is running to the target. This is particularly important across milk bottles, yoghurt cups, cream tubs, dairy dessert pots, and multipacks, where consistency protects both margin and brand trust.

Automation also reduces reliance on operator judgement in a busy production environment. Instead of depending on manual calculations, handwritten checks or delayed quality reviews, operators can see clear weight trends and act on them more quickly. This supports more consistent net content, fewer unnecessary rejects and better control of product giveaway.

2. Smart weight verification and fill control

For dairy producers, the strongest opportunity is often not direct filler control, but smart weight verification. Checkweighers monitor pack weight after filling and provide the data needed to verify process stability, detect drift, and support corrective action. In most milk and yoghurt lines, fillers are set mechanically or volumetrically, so the checkweigher acts as a verification point rather than a direct control loop.

This distinction matters. On a milk bottle or yoghurt cup line, intelligent checkweighing helps production teams understand whether the process is staying close to the declared weight, whether a particular filler head is trending high or low, or whether product behaviour is changing because of temperature, viscosity, foaming, or line conditions. Instead of reacting only after a quality issue has been identified, teams can use checkweigher data to intervene earlier.

In specific dairy applications, true feedback control can still have value. Milk powder is a strong example, because density changes can affect filling behaviour and the value of the product makes even small deviations commercially significant. In these cases, a connected checkweigher may be used to communicate with dosing or filling equipment and help keep average weights closer to target. For most liquid milk and yoghurt lines, however, the priority is accurate verification, drift detection, and operator guidance.

3. Product and portion control where weight matters

Dairy packaging is highly diverse. Products may be packed in bottles, cartons, pouches, cups, tubs, glass jars, or multipacks. They may also vary widely in texture, density and value, from liquid milk and cream to layered desserts, fruit yoghurts, butter portions, grated cheese, milk powder, and premium ingredients. Each format creates different weight control challenges.

In some applications, the issue is not only total pack weight, but the relationship between product components. A layered yoghurt dessert, for example, may need consistent overall net content as well as a uniform balance between base, fruit layer, and topping. Portioned products and multipacks may also need the correct number of pieces or units to correspond with the declared weight.

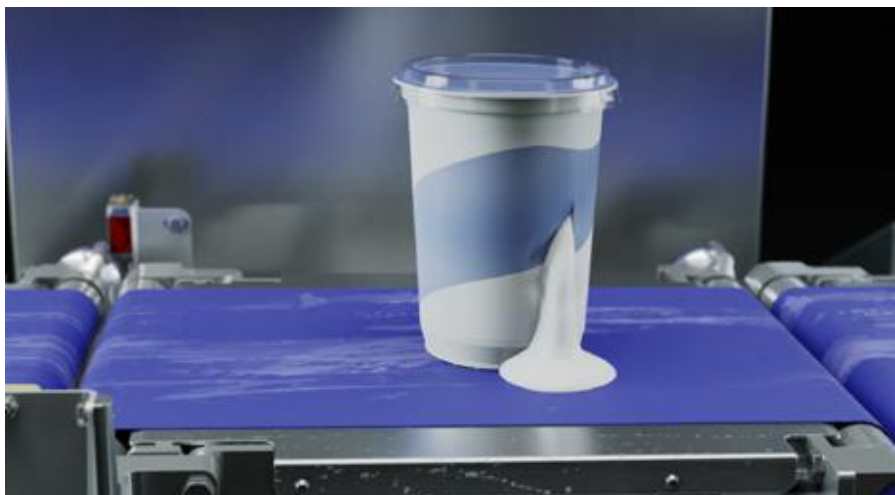
High accuracy weigh cells, multi-station weighing systems, and tare and gross weighing approaches can help dairy producers verify finished pack weight more precisely. This supports label weight compliance and reduces the likelihood of customer complaints linked to underweight, inconsistent, or poorly presented packs. It can also help producers identify where premium ingredients are being used unnecessarily because of overly cautious filling margins.

4. Maintenance, calibration and hygienic readiness

Dairy plants place specific demands on inspection equipment. Moisture, cleaning chemicals, frequent washdown, chilled environments, and continuous production schedules all affect how equipment performs over time. A checkweigher that performs well on day one still needs the right maintenance, verification, and service strategy to maintain stable operation across daily cleaning routines and production peaks.

Washdown ready checkweighers designed for hygienic dairy environments help plants maintain inspection performance in wet processing areas. Smooth surfaces, appropriate ingress protection and cleanable design can reduce hygiene related disruption, while robust construction supports repeatable weighing performance after cleaning cycles.

Regular maintenance, calibration and performance verification are also essential for protecting uptime. If weighing equipment becomes unstable, dairy producers may face more false rejects, greater manual intervention, delayed changeovers, or unexpected stops. A proactive service plan, trained operators, and the right spare parts



“For dairy manufacturers, the challenge is not simply to reduce waste in a general sense. It is to control high volume giveaway while meeting label weight compliance requirements, maintaining consistent pack presentation and keeping wet, high throughput production environments running smoothly. This is particularly important across lines producing milk, yoghurt, cream, desserts, butter, cheese portions, and dairy powders; where pack formats, product behaviour, and production speeds can vary considerably.”

strategy all help reduce production loss. In a sector where lines may run for long shifts and downtime is expensive, reliability is part of margin protection.

5. Data-led continuous improvement on dairy lines

Many dairy producers already collect large volumes of production data. The challenge is turning that data into practical insight. Intelligent checkweighing can help by giving teams a clearer view of giveaway by SKU, filler drift by shift, reject trends, washdown-related recurring issues, and variation between lines or operators.

Connected checkweighers can share information with line systems such as PLCs, MES, SCADA, and ERP platforms; helping production and quality teams identify patterns that would otherwise remain hidden. For example, a plant may find that one SKU consistently runs heavier after a changeover, that a particular shift sees more underweight rejects, or that weighing variation increases after cleaning. Once these patterns are visible, teams can investigate the root cause and take targeted action.

This is where checkweighing becomes more than a compliance tool. It becomes a source of manufacturing intelligence. The same system that rejects an underweight pack can also support decisions about filler settings, maintenance timing, training needs, and line optimisation priorities.

A practical route to lower giveaway

Reducing giveaway in dairy production is not about stripping product out of packs until the process becomes risky. It is about gaining better control. Intelligent checkweighing helps producers work closer to declared weight targets, identify drift sooner, and maintain clearer evidence of process stability.

A practical starting point is to review current lines, maintenance status, and inspection performance. Producers can then identify which machines need verification, calibration, upgrades, or replacement; and where the greatest opportunity exists to reduce giveaway. For some plants, one line or one high value SKU may be the best place to begin. Product testing, an electronic demonstration, or an ROI calculation can then help confirm the right approach before wider rollout.

As dairy manufacturers face continued pressure to reduce high volume giveaway, meet label weight compliance requirements, operate reliably in wet washdown environments, and keep lines running, intelligent checkweighing provides a direct and measurable way forward. It supports the wider role of inspection in modern production: Inspect. Protect. Comply.

For dairy producers, every gram counts. With the right checkweighing strategy, every gram can also be better controlled.

For more information click here or visit: www.mt.com/pi-dairy-webinar-pr

RTD Packaging: Convenience Meets Sustainability



Image: pexels

Packaging Moves Beyond Protection

The global Ready-to-Drink (RTD) beverage industry is evolving rapidly, and packaging is playing a much larger role than simply protecting the product inside. Today, it has become a key factor in influencing consumer buying decisions, enhancing brand identity, supporting sustainability goals, and improving convenience. As demand for ready-to-consume beverages continues to rise worldwide, the RTD Packaging Market is entering a strong growth phase.

According to Polaris Market Research, the global RTD Packaging Market is projected to reach USD 220.77 billion by 2034, registering a compound annual growth rate (CAGR) of 6.20% between 2025 and 2034. The growth reflects changing consumer preferences, expanding urban populations, and the beverage industry's continuous investment in innovative and sustainable packaging solutions.

Convenience Continues to Drive Demand

Modern consumers increasingly seek beverages that fit their busy lifestyles. Whether it is bottled water, cold brew coffee, energy drinks, ready-to-drink teas, juices, or functional beverages, convenience has become one of the strongest drivers shaping packaging demand.

This trend has encouraged beverage manufacturers to adopt packaging formats that are lightweight, durable, portable, and easy to use. PET bottles, aluminum cans, paper cartons, and flexible pouches have emerged as preferred choices because they offer excellent

functionality while simplifying transportation, storage, and consumption. As on-the-go consumption continues to grow across urban markets, packaging is becoming an essential part of the overall consumer experience.

Sustainability Takes Centre Stage

Environmental responsibility is now influencing packaging decisions across the global beverage industry. Governments are introducing stricter regulations on packaging waste, while consumers increasingly expect brands to reduce their environmental footprint. In response, manufacturers are accelerating the adoption of recyclable and eco-friendly materials such as recycled PET (rPET), paper-based cartons, lightweight aluminum, and bio-based packaging solutions. These materials help reduce plastic consumption, lower carbon emissions, and support circular economy initiatives. For beverage brands, sustainable packaging is no longer just a compliance requirement—it has become a competitive advantage that strengthens brand reputation and appeals to environmentally conscious consumers.

Innovation Creates Shelf Appeal

Packaging innovation has become one of the most effective ways for beverage companies to differentiate their products in an increasingly competitive marketplace. Beyond attractive graphics, today's packaging incorporates practical features that improve both safety and convenience.

Resealable caps, tamper-evident closures, ergonomic bottle designs, and smart labels with QR codes are becoming increasingly common across RTD beverage categories. These innovations not only enhance user experience but also enable brands to engage consumers digitally through product information, promotions, and traceability features. Premium beverage segments—including RTD cocktails, cold brew coffees, kombucha, and wellness drinks—are also investing in premium glass bottles and metallic finishes to reinforce quality and exclusivity, while mainstream brands continue to focus on cost-efficient PET bottles and aluminum cans that support large-scale production.

Flexible Packaging Gains Ground

Plastic bottles continue to dominate the RTD packaging market due to their affordability, versatility, and durability across a broad range of beverage applications. However, flexible

packaging is rapidly emerging as one of the industry's fastest-growing segments.

Stand-up pouches and other flexible formats require less material, reduce transportation costs, and offer excellent portability, making them particularly attractive for single-serve beverages and younger consumers seeking convenience. Glass bottles continue to retain their importance in premium and alcoholic beverages, while aluminum cans remain the preferred option for energy drinks, sparkling beverages, and flavored water because of their high recyclability and superior cooling performance.

Asia Pacific Emerges as a Growth Hotspot

North America currently leads the global RTD packaging market, supported by a mature beverage industry, advanced retail infrastructure, and widespread adoption of sustainable packaging technologies.

However, the spotlight is gradually shifting toward the Asia Pacific region, which is expected to record the fastest growth over the coming years. Rapid urbanization, rising disposable incomes, expanding organised retail, and increasing consumption of packaged beverages in countries such as India, China, and Japan are creating significant opportunities for packaging manufacturers. Meanwhile, Europe continues to drive innovation through stringent sustainability regulations aimed at reducing single-use plastics and promoting recyclable packaging.

The Road Ahead

Leading packaging companies—including Tetra Laval Group, Amcor Limited, Ball Corporation, Crown Holdings, Ardagh Metal Packaging, SIG Combibloc, Smurfit Kappa, and WestRock Company—are investing heavily in recyclable materials, lightweight designs, smart packaging technologies, and strategic partnerships to strengthen their market positions. As beverage brands compete for consumer attention, packaging is becoming a strategic business asset rather than a secondary consideration. The combination of convenience, sustainability, premium aesthetics, and digital connectivity is shaping the next generation of RTD packaging.

With consumers demanding products that are easy to carry, environmentally responsible, and visually appealing, the Ready-to-Drink Packaging Market is well positioned for sustained growth. Companies that successfully balance innovation with sustainability will be best placed to capture opportunities in one of the world's fastest-evolving beverage packaging segments.

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The New Face of Food Packaging: What's Driving Industry Change Today

A. R. Parmar, B. L. Jani, N. U. Joshi, V. D. Kukadiya, J. R. Jat



Introduction

The humble food package has undergone a remarkable metamorphosis. What was once merely a practical container designed to protect products during transit has evolved into something far more complex—a sophisticated tool that shapes consumer choices, communicates brand values, and addresses pressing environmental concerns. Food manufacturers find themselves at a pivotal moment where packaging decisions carry unprecedented weight, influencing everything from shelf appeal to regulatory compliance and environmental footprint. This transformation reflects broader shifts in consumer expectations and technological capabilities. Today's shoppers approach supermarket aisles with heightened awareness, scrutinizing not just what's inside the package but the package itself. They ask questions about recyclability, material origins, and end-of-life disposal. Meanwhile, manufacturers grapple with competing demands: reducing environmental impact while maintaining product freshness, embracing innovative materials without compromising safety, and creating visually distinctive designs that stand out in increasingly crowded retail environments.

The convergence of these forces has created a dynamic landscape where packaging innovation moves at breakneck speed. Food brands that once relied on decades-old packaging formats now regularly reassess their choices, driven by sustainability targets, regulatory changes, and shifting consumer preferences. This article explores the key demands shaping today's food packaging industry, examining how brands navigate the complex terrain between environmental

responsibility, functional performance, and commercial viability.

The Sustainability Imperative

Environmental considerations have moved from peripheral concern to central strategy in food packaging decisions. Consumers increasingly view packaging through an ecological lens, expecting brands to demonstrate tangible commitment to reducing waste and resource consumption. This shift has catalyzed significant material innovations, with manufacturers exploring alternatives to conventional plastic laminates that historically provided excellent barrier properties but proved difficult to recycle. Single-material packaging solutions have emerged as a promising response to recycling challenges. By transitioning from multi-layer constructions that combine different materials to mono-material structures using polyethylene or polypropylene, manufacturers create packages that traditional recycling facilities can process. This approach maintains essential protective properties while enabling circular material flows. However, achieving comparable performance to multi-material laminates requires sophisticated engineering and material science expertise.

Paper-based solutions have gained considerable traction, particularly in dry goods and secondary packaging applications. Advances in barrier coatings now enable paper to protect against moisture and oxygen, extending its utility beyond traditional uses. Yet paper packaging faces its own challenges, including ensuring adequate protection for moisture-sensitive products and maintaining structural integrity throughout distribution chains.

The lightweighting movement represents another significant sustainability strategy. By reducing material usage through improved design and engineering, manufacturers decrease both environmental impact and transportation costs. Even modest weight reductions in high-volume categories translate to substantial cumulative savings and emissions reductions. This approach demonstrates that sustainability and economic efficiency can reinforce each other when approached thoughtfully.

Smart Packaging and Digital Integration

Technology integration has transformed packaging from passive container to active communication channel. Quick Response codes, near-field communication tags, and digital watermarks create bridges between physical products and digital experiences, enabling unprecedented levels of consumer engagement and supply chain visibility.

These smart packaging features serve multiple functions simultaneously. Consumers gain access to detailed product information—origin stories, sustainability credentials, nutritional data, and recipe suggestions—through simple smartphone interactions. Brands benefit from enhanced traceability, anti-counterfeiting capabilities, and direct consumer engagement channels. The data generated through these interactions provides valuable insights for marketing, supply chain optimization, and product development.

Freshness indicators and time-temperature monitors represent another dimension of intelligent packaging. These sensors provide visual cues about product condition, reducing food waste by helping consumers make informed decisions about product freshness. For retailers and manufacturers, this technology reduces returns and enhances customer satisfaction while supporting food safety objectives.

Convenience and Consumer Experience

Modern lifestyles demand packaging that accommodates busy schedules without sacrificing quality or sustainability. Resealable features, portion control options, and microwave compatibility have become expected rather than exceptional. Brands invest in advanced closure technologies and ergonomic designs that enhance user experience while maintaining product

freshness and safety. The unboxing experience has emerged as a distinct consideration, particularly for direct-to-consumer channels. Packaging must protect products during extended shipping while creating positive first impressions that reinforce brand positioning. This dual requirement has driven innovation in protective packaging that minimizes waste while ensuring damage-free delivery.

Single-serve formats continue to grow in popularity, responding to consumer demand for convenience and portion management. However, these formats face sustainability scrutiny, driving development of recyclable and compostable options that maintain convenience benefits while reducing environmental impact.

Premium Aesthetics and Brand Differentiation

Visual appeal remains crucial in competitive retail environments. Brands invest in distinctive packaging designs that communicate quality, authenticity, and values. Matte finishes, tactile elements, embossing, and metallic accents create sensory experiences that differentiate products on crowded shelves. Glass packaging maintains its premium positioning despite higher weight and transportation costs. Its perceived purity, recyclability, and traditional associations appeal to consumers seeking quality and authenticity. However, glass faces competition from advanced plastic and paper alternatives that offer similar aesthetic qualities with reduced environmental impacts.

Minimalist design approaches have gained popularity, particularly in health-focused and natural product categories. Clean typography, muted color palettes, and transparent packaging communicate simplicity and authenticity, aligning with consumer preferences for transparency and natural ingredients.

Supply Chain and Operational Considerations

E-commerce growth has fundamentally altered packaging requirements. Products now navigate complex distribution networks with varying temperatures, handling conditions, and transit times. Packaging must protect against compression, temperature fluctuations, and physical impacts while maintaining visual appeal for the unboxing experience. Secondary packaging plays increasingly important roles in protecting primary containers and enabling efficient logistics. Corrugated packaging designs must balance strength with material efficiency, protecting products while minimizing environmental impact. Innovations in packaging design and materials help achieve these sometimes conflicting objectives.

Technology integration has transformed packaging from passive container to active communication channel. Quick Response codes, near-field communication tags, and digital watermarks create bridges between physical products and digital experiences, enabling unprecedented levels of consumer engagement and supply chain visibility. These smart packaging features serve multiple functions simultaneously. Consumers gain access to detailed product information—origin stories, sustainability credentials, nutritional data, and recipe suggestions—through simple smartphone interactions.

Temperature-sensitive products require specialized packaging solutions that maintain required conditions throughout distribution. Insulated packaging, phase-change materials, and thermal monitoring technologies help ensure product quality and safety while enabling broader distribution networks.

Regulatory and Safety Compliance

Food safety regulations continue to evolve, with increasing scrutiny of packaging materials and their potential interactions with food products. Migration limits, substance restrictions, and documentation requirements demand rigorous compliance programs and thorough material testing. Concerns about mineral oil hydrocarbons and per- and polyfluoroalkyl substances have driven development of alternative materials that maintain performance while eliminating concerning substances. Manufacturers must navigate complex regulatory landscapes while maintaining product protection and shelf life.

Traceability requirements extend throughout supply chains, requiring comprehensive documentation and testing protocols. Packaging suppliers increasingly provide detailed compliance documentation, migration test results, and material declarations to support brand partners' regulatory obligations.

Future Directions and Innovation Horizons

Refillable and reusable packaging systems represent a significant frontier, particularly in urban markets with developed infrastructure. These systems offer potential for substantial single-use packaging reduction while creating new consumer engagement models. However, implementation requires significant investment and supply chain coordination.

Bio-based materials continue to evolve, with improved performance and cost profiles expanding their applications.



Polylactic acid, polyhydroxyalkanoates, and starch-based materials offer renewable alternatives to petroleum-based plastics, though challenges remain in end-of-life management and barrier performance.

Digital printing technologies enable greater agility and personalization, allowing brands to respond quickly to market trends and consumer preferences. Short-run production capabilities reduce waste and enable localized marketing campaigns that resonate with specific consumer segments.

Conclusion

The food packaging industry stands at an inflection point where environmental, technological, and consumer forces converge. Success requires navigating complex trade-offs between competing priorities while maintaining product quality, safety, and commercial viability. Brands that embrace innovation across multiple dimensions—sustainability, technology, convenience, and aesthetics—will emerge as leaders in this transformed landscape. The integration of smart technologies, sustainable materials, and consumer-centric design represents the future of food packaging. As regulatory pressures increase and consumer expectations evolve, packaging will continue to evolve from simple container to strategic asset. Companies investing in research and development, supply chain innovation, and consumer engagement will shape not only their own success but the broader trajectory of the food industry. This transformation presents both challenges and opportunities. Those who approach packaging as an integrated element of brand strategy rather than operational necessity will find themselves well-positioned to meet evolving demands while building lasting consumer trust and loyalty. The future belongs to brands that view packaging not as a cost center but as a distinctive capability that differentiates their products and strengthens their market position.

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Brewing the Future:

Independence Brewing Company on Premiumisation, Innovation & India's Evolving Beer Market

As India's beer industry enters a new phase of premiumisation and evolving consumer preferences, brands are redefining the way beer is brewed, packaged, and experienced. From craft brewing and immersive hospitality to canned formats, sustainability, and flavour innovation, the sector is witnessing rapid transformation driven by a new generation of discerning consumers. In an exclusive conversation with Food & Beverage Processing magazine, Rahul Mehra, CEO of Independence Brewing Company (IBC), shares the company's journey, its brewing philosophy, the growing demand for premium beer experiences, and his outlook on the future of India's dynamic beer market.



Anirudh Khanna, Managing Director, Independence Brewing Company

Independence Brewing Company has been among the pioneers of India's beer movement. Could you briefly share the brand's journey and its vision for the evolving Indian beer market?

Since 2011, when the beer industry was only getting started, Independence Brewing Company has been a part of India's beer journey. Over the years, rather than just providing a beverage, we have concentrated on introducing customers to a broader range of beer styles, brewing methods, and experiences while creating a culture around beer. Throughout its network of bars, IBC has developed into a hospitality-driven brand that offers excellent food, beer, and community-focused experiences.

Our conviction that Indian consumers are becoming more inquisitive, astute, and willing to try new things has not changed over the course of our journey. Customers now choose beer based on quality, authenticity, taste profiles, and unforgettable experiences rather than just familiarity or price. Our growth and innovation strategy has been greatly influenced by this progression.

We think the Indian beer market is about to enter a really fascinating era. For companies like ours, new opportunities are being created by premiumization, changing consumption occasions, and an increasing respect for products. Our goal is to keep growing the ways that customers interact with the brand, whether through our pubs, new product forms, or creative beer experiences, even if beer is still our cornerstone. Our ultimate objective is to significantly contribute to the development of a more developed, varied, and internationally competitive beer culture in India.

The beer segment in India has witnessed significant growth in recent years. What key trends are currently shaping consumer preferences and purchasing behaviour in this category?

Over the past few years, the Indian beer market has undergone significant change thanks to a new generation of consumers that are more knowledgeable, daring, and experience-driven than ever. Premiumization is one of the most notable developments we are witnessing. Customers are willing to pay more for companies that offer authenticity and a strong point of view, as well as for better quality, unique flavours. The increasing need for variety is another significant change. Compared to ten years ago, consumers nowadays are experimenting with various beer varieties and are much more willing to try new things. In addition to encouraging brewers to experiment with different styles, forms, and drinking occasions, this interest has helped beer become more popular.

Additionally, we're seeing a closer relationship between experiences and beer. Customers are searching for social, community-driven settings where cuisine, music, culture, and hospitality converge rather than just the product itself. This is among the reasons why urban consumers are still drawn to brewery-led and immersive models. Accessibility and convenience are also becoming more and more crucial. As the market develops, consumers want to be able to enjoy high-quality beer at a variety of locations, including restaurants, bars, and homes. This is spurring innovation in both product and consumer engagement strategies.

In general, I think the market is becoming more sophisticated. Instead of just familiarity,

consumers are making decisions based on brand values, experience, and quality. That's good news for the industry since it allows space for significant innovation and sustained category expansion.

Premiumisation continues to influence the alcoholic beverage industry. How is IBC responding to consumers' growing demand for distinctive flavours, quality ingredients, and premium drinking experiences?

Premiumization has evolved from a fringe trend to a defining feature of contemporary Indian consumers. Consumers nowadays are looking for goods that provide authenticity, quality, and a deeper experience; this change is especially noticeable in the beer market. At Independence Brewing Company, our philosophy has always guided our response. We prioritise using premium ingredients to brew beers, keeping batches consistent, and providing a wide range of types to suit different customer tastes. Premiumization, in our opinion, is about providing superior quality, flavour, and workmanship in every consumer engagement with the brand, not just about making a more expensive product.

The experience that surrounds the product is as vital. We want to establish venues where customers can try new beers, experiment with food pairings, and interact with the brand more deeply through our bars and hospitality-led strategy. We continue to invest in experiences that feel genuine, well chosen, and unforgettable because we've discovered that customers value these things more and more. Another important factor is innovation. New forms and more complex flavour profiles are becoming more and more popular as customer preferences change. Our goal is to

be aware of these changes while upholding the values of craftsmanship and quality that have characterised IBC since its founding.

Raising the category's general standard is the ultimate goal of premiumization. Brands have an opportunity and an obligation to provide goods and services that truly stand out as consumers get more discriminating. We will keep using that strategy as we expand the IBC brand.

Canned beer is emerging as one of the fastest-growing packaging formats. What advantages does this format offer both consumers and brands, and how do you see its role evolving in the Indian market?

The rising demand for canned beer reflects broader changes in consumer consumption patterns and lifestyles, with convenience, portability, and quality becoming key priorities for today's consumers. The can format offers easy transportation, quick chilling, and suitability for a wide range of occasions, from home gatherings to outdoor events, while preserving the beer's freshness and flavour. From a brand perspective, cans provide greater distribution flexibility, enable wider accessibility to premium-quality beer, and maintain product consistency through modern canning technology. At Independence Brewing Company, the move into canned beer was driven by the vision of extending the IBC experience beyond its bars and hospitality venues without compromising on the character and quality of its beers. Looking ahead, the company believes canned beer will continue to gain significance in the Indian market, emerging as a key growth driver in the premium beer segment by complementing traditional formats and creating new opportunities for consumer engagement.

As competition intensifies across the premium beer segments, what differentiates IBC from other players in terms of product innovation, brewing philosophy, and consumer engagement?

The premium beer market has grown more vibrant, which is good for business since it promotes innovation and raises customer expectations. Differentiation in this setting comes from a persistent dedication to quality, authenticity, and customer experience rather than from a particular product or promotion. Brewing has always been the cornerstone of Independence Brewing Company. Our goal has always been to produce beers that are tasty, approachable, and showcase the artistry involved in the brewing process. We keep investing in innovation to make sure we

are truly responding to changing consumer preferences and drinking situations, not for the sake of novelty.

Another key differentiator for us is our community-first approach. We've always thought of beer as a component of a broader social experience. Customers can interact with the brand through our bars and experience places in ways that go beyond the product itself, such as trying out new looks, experimenting with food combinations, or just taking part in a lively community environment. Today, authenticity is the foundation of consumer engagement. Consumers today are interested in learning about a brand's history, production process, and core values. Since IBC's founding, we have concentrated on creating real connections through reliable experiences, high-quality products, and an open and experimental culture.

In the end, even if products and formats will keep changing, we think that what sets us apart is our ability to combine brewing knowledge with a strong hospitality mindset and a thorough awareness of what today's customers are searching for. This balance has been essential to our progress thus far and will continue to direct us as the category expands.

Sustainability is becoming an important consideration across the beverage industry. What initiatives is IBC undertaking in areas such as sourcing, brewing efficiency, packaging, and environmental responsibility?

For good reason, the brewing sector is focusing more and more on sustainability. It is our duty as brewers to strike a balance between environmental stewardship and growth, and to make sure that our companies are robust, effective, and conscious of their influence. At IBC, we see sustainability as a continuous process rather than a singular project. We constantly search for ways to increase operational effectiveness, maximise resource utilisation, and make more ethical decisions about how we brew, package, and distribute our goods throughout the value chain. These factors are becoming essential to how breweries function and innovate as the business changes.

From a sourcing standpoint, the sector is increasingly focusing on bolstering local supplier ecosystems whenever possible. This helps to lessen the environmental effect of lengthy and intricate supply chains in addition to promoting increased agility and quality control. Efficiency is still a top concern in brewing facilities. Breweries are increasing consistency while lowering resource intensity because to developments in brewing technology and process optimisation. We

have made investments in cutting-edge brewing and production equipment at our recently built brewing facility that are intended to provide quality and operational efficiency at scale.

Another area where significant advancements can be achieved is packaging. The increasing use of recyclable formats, such as aluminium cans, is indicative of a larger trend in the industry toward solutions that strike a compromise between sustainability and consumer convenience. Responsible packaging decisions will remain crucial as businesses grow across platforms. In the end, sustainability is about creating a more robust and future-ready industry rather than merely adhering to regulations or satisfying customer demands. As I've previously stated, beer's future depends on striking the correct balance between quality, innovation, and more ethical brewing methods. Businesses who incorporate these ideas into their long-term strategy, in our opinion, will be in the best position to expand sustainably.

Looking ahead, what are IBC's key growth priorities, and how do you see the beer industry evolving in India over the next few years?

Strengthening the IBC brand, expanding customer access, and continuing to innovate in line with evolving consumer preferences remain the company's key priorities. Building on its strong hospitality foundation and recent entry into the bottled beer segment, IBC aims to expand its reach while maintaining the craftsmanship, quality, and consistency associated with the brand. The company also sees significant opportunities in creating new consumption occasions, strengthening its retail presence, and leveraging its extensive hospitality experience. Looking ahead, IBC believes the Indian beer market is entering an exciting phase, driven by premiumisation, demand for authentic and high-quality experiences, and growing interest in new beer styles and formats. As beer becomes increasingly experience-driven, brands that combine superior products with meaningful consumer engagement will be best positioned for future growth.

I anticipate that the difference between traditional beer brands and experience-driven beer brands will become even more noticeable in the coming years. Those that can successfully blend superior brewing with innovation, accessibility, and solid customer relationships will emerge victorious. The chance for us at IBC is to continue influencing India's changing beer culture while adhering to the spirit of freedom, experimentation, and hospitality that has characterised our path from the start.



Black Pepper: The Timeless King of Spices in Modern Food Innovation

Kanika Banga

A Spice That Shaped Global Trade

Few agricultural commodities have influenced the course of human civilization as profoundly as black pepper. Often referred to as the "King of Spices," black pepper has been prized for over two thousand years, not only for its distinctive flavour but also for its remarkable economic value. Derived from the dried, unripe berries of the *Piper nigrum* vine, native to India's Malabar Coast in Kerala, black pepper was once so valuable that it was used as currency and often called "black gold." Ancient Roman traders, Arab merchants, and later European explorers established extensive trade routes to secure supplies of this precious spice, making it one of the driving forces behind global maritime exploration and international commerce.

Today, while black pepper is readily available across the world, its significance remains undiminished. It is one of the most widely traded spices globally and continues to be an essential ingredient in households, restaurants, food processing industries, and premium culinary applications. Its ability to enhance flavour naturally while complementing almost every cuisine has secured its position as one of the most indispensable spices in the modern food industry.

Botanical Characteristics and Processing

Black pepper is harvested from the flowering vine *Piper nigrum*, which thrives in warm, humid tropical climates. The berries are picked while still green and immature before undergoing drying under controlled conditions. During drying, enzymatic reactions and oxidation cause the berries to develop their characteristic wrinkled black exterior and concentrated flavour. Depending on harvest timing and processing methods, the same pepper plant also produces green pepper, white pepper, and red pepper, each offering unique flavour characteristics. Black pepper,

however, remains the most commercially important due to its robust aroma, balanced pungency, and versatility across countless food applications.

Flavor Profile and Functional Versatility

The popularity of black pepper stems from its exceptionally balanced flavour profile. It delivers a sharp, pungent heat that is complemented by earthy, woody, floral, and mildly citrusy undertones. Unlike chilli peppers, whose heat comes from capsaicin, black pepper derives its characteristic pungency from piperine, which provides a warm, lingering sensation without overwhelming the palate.

This complex sensory profile enables black pepper to function both as a primary seasoning and as a flavour enhancer. Rather than masking existing flavours, it elevates and balances them, making it an essential component in countless food formulations. From soups, gravies, sauces, marinades, spice blends, salad dressings, and seasonings to savoury snacks, instant noodles, frozen foods, ready meals, and gourmet products, black pepper contributes depth, aroma, and complexity that appeal to consumers across diverse markets.

Its compatibility with herbs such as rosemary, thyme, oregano, basil, parsley, garlic, ginger, turmeric, cumin, coriander, and paprika further enhances its versatility, allowing food developers to create sophisticated flavour profiles with minimal ingredient complexity.

Black Pepper in Modern Food Manufacturing

In today's food processing industry, black pepper is far more than a household seasoning. It serves as a strategic ingredient across multiple product categories owing to its consistent flavour, natural positioning, and broad consumer acceptance.

Processed meat manufacturers rely heavily on black pepper for sausages, cured meats, salami, meatballs, burgers, and deli products, where it contributes both flavour and aroma. With the rapid growth of plant-based meat alternatives, black pepper has also become an essential ingredient in vegan burgers, meat substitutes, and textured vegetable protein products, helping replicate the complexity traditionally associated with meat. The bakery sector incorporates black pepper into savoury biscuits, crackers, breadsticks, artisan breads, cheese products, and gourmet baked snacks. Snack manufacturers utilize it extensively in potato chips, extruded snacks, popcorn, roasted nuts, trail mixes, and seasoning powders to create premium flavour variants that appeal to evolving consumer preferences.

Convenience food manufacturers increasingly depend on black pepper in ready-to-eat meals, instant soups, frozen entrees, meal kits, pasta sauces, and microwaveable products. Its natural flavour enhancement properties help maintain product quality while supporting cleaner ingredient declarations.

Forms Used in Food Processing

Food manufacturers utilize black pepper in several commercial forms depending on processing requirements and end-use applications. Whole peppercorns are commonly used in premium retail products, pickling, and spice mills. Cracked pepper provides visual appeal and stronger bursts of flavour in processed meats, gourmet snacks, and seasoning blends. Ground black pepper remains the most widely used format for seasoning applications across industrial food production.

For large-scale manufacturing, black pepper oleoresin has become increasingly important. Produced through solvent extraction, oleoresin delivers concentrated flavour compounds with excellent consistency, controlled dosage, improved storage stability, and minimal microbial contamination risk. Since oleoresins eliminate variability associated with whole spices, they are widely used in processed foods, sauces, instant mixes, seasonings, beverages, and pharmaceutical formulations. Black pepper essential oil is also gaining popularity in flavour systems, nutraceuticals, and specialty food applications where aromatic characteristics are particularly valued.

Nutritional and Health-Driven Appeal

Beyond its culinary significance, black pepper has attracted considerable scientific interest due to the functional properties of piperine. Research suggests that piperine may support digestive health by stimulating digestive enzyme secretion and enhancing gastrointestinal function.

Perhaps its most widely recognised benefit is its ability to improve the bioavailability of several nutrients and bioactive compounds. Piperine has been shown to enhance the absorption of curcumin from turmeric, as well as certain vitamins, minerals, and antioxidants, making it a valuable ingredient in functional foods and dietary supplements.

Black pepper also contains naturally occurring antioxidants that help combat oxidative stress. Although consumed in relatively small quantities, it contributes beneficial phytochemicals that support overall wellness. Traditional medicinal systems, including Ayurveda, have long incorporated black pepper into formulations intended to promote respiratory health, metabolism, and digestive balance. As consumers increasingly seek foods that combine taste with wellness benefits, black pepper aligns perfectly with current trends toward functional nutrition, clean-label ingredients, and naturally derived flavour solutions.

Growing Demand in Functional and Clean-Label Foods

The clean-label movement has significantly strengthened black pepper's market position. Food manufacturers are increasingly replacing artificial flavour enhancers and synthetic additives with natural spices that consumers recognize and trust. Black pepper fits seamlessly into this transition. Its multifunctional properties allow manufacturers to deliver flavour enhancement while maintaining ingredient transparency. Functional beverages, protein products, herbal teas, nutritional supplements, immunity-focused formulations, and fortified foods increasingly incorporate black pepper or piperine extracts to improve both sensory appeal and nutritional performance. The growing popularity of minimally processed foods has further reinforced consumer preference for natural spices such as black pepper, supporting innovation across health-focused product categories.

Applications Across Global Cuisines

Few spices enjoy the universal acceptance of black pepper. Its versatility transcends geographical boundaries, making it one of the world's most adaptable ingredients. In European and North American cuisines, black pepper serves as a universal table condiment and foundational seasoning for meat, seafood, vegetables, pasta, eggs, and soups. French cuisine relies heavily on cracked pepper for sauces and steak preparations, while Italian cooking incorporates it extensively in pasta, pizza, and cured meats.

Across Asia, black pepper plays a central

Consumer preferences continue to evolve toward authentic flavours, natural ingredients, and healthier food choices, placing black pepper in an exceptionally strong position for future growth. Innovations in encapsulated pepper extracts, standardized oleoresins, precision flavour systems, and functional ingredient formulations are expanding its applications beyond traditional seasoning. The rising popularity of convenience foods, premium snacks, plant-based proteins, gourmet cooking, and functional nutrition is expected to sustain global demand for high-quality black pepper.

role in curries, stir-fries, noodle dishes, spice blends, sauces, and marinades. It is equally important in Middle Eastern spice mixtures, African meat preparations, Latin American seasonings, and fusion cuisine. This global familiarity allows food manufacturers to develop internationally appealing products without introducing unfamiliar flavours. Black pepper provides consistency across markets while supporting regional flavour customization.

Quality Parameters and Processing Considerations

The quality of black pepper depends on multiple factors, including cultivation practices, harvesting stage, drying methods, grading, and storage conditions. Premium black pepper typically exhibits high volatile oil content, strong aroma, uniform berry size, low moisture levels, and high piperine concentration.

Modern processing facilities employ advanced cleaning, grading, steam sterilization, cryogenic grinding, metal detection, and quality assurance systems to ensure microbiological safety and flavour consistency. Proper packaging in moisture-resistant materials helps preserve volatile oils and extends shelf life, particularly for export markets. Increasingly, buyers also demand compliance with stringent food safety standards, including traceability, pesticide residue limits, microbial quality, and sustainability certifications.

Global Production, Sourcing, and Sustainability

The global black pepper supply chain continues to evolve as demand increases across food, pharmaceutical, cosmetic, and nutraceutical industries. Vietnam currently leads global black pepper production and exports, while India, Indonesia, Brazil, Sri Lanka, and several Southeast Asian countries remain significant producers. India continues to enjoy a premium reputation for

specialty pepper varieties, particularly those originating from the Western Ghats, where traditional cultivation practices contribute to distinctive flavour profiles.

Sustainability has become an increasingly important consideration throughout the pepper value chain. Buyers are encouraging responsible agricultural practices that promote biodiversity, soil conservation, efficient water use, reduced chemical inputs, and fair livelihoods for farmers. Traceability systems, sustainable sourcing programs, and certification schemes are becoming key differentiators, particularly among premium food manufacturers and export-oriented brands seeking greater supply chain transparency.

Future Outlook: Innovation with a Timeless Ingredient

Consumer preferences continue to evolve toward authentic flavours, natural ingredients, and healthier food choices, placing black pepper in an exceptionally strong position for future growth. Innovations in encapsulated pepper extracts, standardized oleoresins, precision flavour systems, and functional ingredient formulations are expanding its applications beyond traditional seasoning. The rising popularity of convenience foods, premium snacks, plant-based proteins, gourmet cooking, and functional nutrition is expected to sustain global demand for high-quality black pepper. Advances in processing technologies will further improve flavour consistency, shelf stability, and formulation flexibility, enabling manufacturers to meet evolving consumer expectations without compromising natural appeal.

A Timeless Ingredient for Modern Food Innovation

Despite the emergence of countless exotic spices and global flavour trends, black pepper continues to reign as the world's most versatile and widely accepted spice. Its unique combination of sensory appeal, functional performance, nutritional value, and clean-label compatibility makes it indispensable across virtually every segment of the food industry.

For food manufacturers, product developers, chefs, and culinary innovators, black pepper represents far more than a traditional seasoning. It is a strategic ingredient that connects centuries of culinary heritage with the demands of modern food science, helping create products that satisfy consumers' expectations for flavour, authenticity, nutrition, and sustainability. As the food industry continues to innovate, the "King of Spices" is poised to remain at the heart of global food production for generations to come.

Clear Whey Protein: The Refreshing Innovation Driving the Future of Sports Nutrition



The global sports nutrition industry is undergoing a significant transformation as consumers increasingly seek healthier, lighter, and more refreshing alternatives to conventional protein supplements. Clear whey protein has emerged as one of the fastest-growing categories within the functional nutrition market, offering a juice-like, high-protein beverage that appeals to fitness enthusiasts as well as health-conscious consumers. According to recent market research, the global clear whey protein market is projected to grow from USD 556.3 million in 2025 to USD 1,006.4 million by 2034, registering a compound annual growth rate (CAGR) of 6.9% during the forecast period. The market is expected to reach USD 592.1 million in 2026, reflecting strong consumer adoption and sustained demand across global markets.

A Refreshing Alternative to Traditional Protein Supplements

Unlike conventional whey protein shakes, which are typically creamy and milk-based, clear whey protein is formulated using whey protein isolate to create a transparent, juice-style beverage. The product dissolves easily in water and delivers high-quality protein in a light, refreshing format with flavours such as lemonade, fruit punch, watermelon, and mixed berries. Available in both powder and ready-to-drink (RTD) formats, clear whey protein combines high protein content with low sugar and low calorie levels, making it attractive to consumers seeking convenient post-workout recovery and everyday

Despite robust market expansion, pricing remains one of the key challenges. The production of whey protein isolate requires advanced filtration and processing technologies, resulting in higher manufacturing costs compared with conventional protein products. These costs are reflected in retail pricing, which may restrict adoption in price-sensitive markets across developing economies. Improving affordability while maintaining product quality will be essential for companies seeking wider market penetration in regions such as Southeast Asia and Latin America.

nutritional support without the heaviness associated with traditional protein shakes.

Market Trends and Segment Performance

The market continues to be dominated by whey protein isolate, which accounted for 77.7% of total revenue in 2025. Its popularity stems from its high protein concentration, low fat content, and ability to produce clear beverages with excellent taste and texture.

Sports nutrition remains the largest application segment, representing 63.5% of the market in 2025. Rising participation in gyms, recreational sports, and fitness activities worldwide has significantly boosted demand for protein-based recovery products. Distribution is increasingly shifting online, with e-commerce accounting for 39.8% of

market revenue as consumers continue to purchase nutritional supplements through direct-to-consumer platforms and digital retail channels.

Regionally, North America held the largest market share at 40.63% in 2025, supported by a well-established sports nutrition industry, high consumer awareness, and strong spending on functional foods. Meanwhile, Asia-Pacific is expected to register the fastest growth, expanding at a CAGR of 7.4% through 2034. Rapid urbanization, increasing disposable incomes, expanding gym memberships, and the growth of e-commerce platforms in countries such as China, India, Japan, and South Korea are driving regional demand.

Key Factors Driving Market Growth

Growing global participation in fitness activities remains the primary driver of the clear whey protein market. Public health initiatives encouraging more active lifestyles, combined with rising awareness of the health benefits of adequate protein intake, are expanding the consumer base beyond professional athletes to include recreational exercisers and wellness-focused individuals.

Another major growth factor is the increasing consumer preference for healthier beverages. Today's consumers are actively seeking products that combine nutritional benefits with lower sugar, fewer calories, and cleaner ingredient labels. Clear whey protein effectively addresses these preferences by providing muscle recovery benefits while offering the taste and refreshment of a fruit beverage. Innovation within the ready-to-drink segment is also accelerating market expansion. Manufacturers are introducing convenient protein beverages that appeal to consumers looking for on-the-go nutrition without compromising taste or nutritional quality.

Product Innovation Continues to Expand Consumer Choice

Leading nutrition brands are investing heavily in product innovation to strengthen their position in the growing clear whey protein category. In July 2025, Myprotein introduced a ready-to-drink clear whey protein beverage packaged in 500 ml bottles containing 20 grams of protein. Bloom Nutrition followed in January 2026 with Bloom Clear Protein, a juice-style whey protein drink providing 20 grams of protein per serving. Further innovation came in March 2026 when Orgain launched its Clear Protein Powder at Expo West. The product delivers 22 grams of protein with zero sugar and only 100 calories per serving, highlighting the industry's focus on clean-label formulations that combine convenience, nutrition, and taste.

Competitive Landscape Intensifies

The global clear whey protein market is highly competitive, with established nutrition companies and emerging brands competing through product innovation and brand differentiation. Major participants include Glanbia plc, The Hut Group (Myprotein), BellRing Brands, PepsiCo, Abbott Laboratories, Nestlé S.A., Dymatize, Applied Nutrition plc, BioTechUSA, Orgain, Muscletech, and Sports Supplements Ltd (Bulk).

Companies are increasingly focusing on flavour development, clean-label formulations, functional ingredient additions such as electrolytes, collagen, vitamins, and adaptogens, along with influencer marketing and omnichannel distribution strategies to strengthen consumer engagement. The United Kingdom continues to be one of the leading markets for clear whey protein. Consumer demand has grown rapidly, with Amazon sales of clear protein powders increasing by 216% in 2023 compared with the previous year, encouraging manufacturers across Europe to expand their product portfolios.

Challenges Remain Despite Strong Growth Prospects

Despite robust market expansion, pricing remains one of the key challenges. The production of whey protein isolate requires advanced filtration and processing technologies, resulting in higher manufacturing costs compared with conventional protein products. These costs are reflected in retail pricing, which may restrict adoption in price-sensitive markets across developing economies. Improving affordability while maintaining product quality will be essential for companies seeking wider market penetration in regions such as Southeast Asia and Latin America.

Future Opportunities in Functional Nutrition

The future of the clear whey protein market is expected to be shaped by continued product innovation and functional enrichment. Manufacturers are increasingly incorporating additional health-promoting ingredients such as electrolytes, B vitamins, collagen peptides, and adaptogens to position clear whey protein as a comprehensive wellness beverage rather than solely a sports nutrition product. Specialty retail outlets, including health food stores, supplement retailers, and wellness boutiques, are also expected to become one of the fastest-growing distribution channels through 2034. These stores provide consumers with expert product guidance and reinforce the premium positioning of clear whey protein products.

Outlook

Clear whey protein has evolved from a niche sports nutrition product into a rapidly expanding segment within the global functional foods industry. Supported by changing consumer preferences, ongoing product innovation, and increasing demand for healthier beverage options, the market is expected to surpass USD 1 billion by 2034. As competition intensifies, companies that focus on innovation, affordability, geographic expansion, and consumer education will be best positioned to capitalize on the significant opportunities emerging in this dynamic market.

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Sugar vs. Substitutes: What Science Really Says about Sweeteners

Payoshni S. Joshi



1. Introduction

Sugar reduction is now a consumer-driven and regulatory mandate that is subtly changing product portfolios throughout the food and beverage industry, rather than a fleeting wellness trend. The market for sugar-free food and beverages is expected to almost double, from approximately USD 72.98 billion in 2026 to roughly USD 107.94 billion by 2031, thanks to sugar tariffs, stricter label regulations, and health-conscious consumers. This change is more complicated than it seems for manufacturers. When sugar is substituted, the original product's taste, texture, shelf life, and cost per unit are all preserved while maintaining the label promises that modern customers scrutinize more than ever. When a constantly changing scientific and regulatory landscape is included, formulation choices begin to have actual commercial significance rather than merely technical ones.

2. Market & Regulatory Pressures Driving Reformulation

One of the most obvious financial tools advancing reformulation is the sugar tax. The average sugar content of all taxed beverage categories has significantly decreased in several markets that have implemented sugar-based taxes; some areas have reported sugar-per-liter drops of more than 40% after implementation. This has prompted other areas to take into account comparable tiered tax arrangements, indicating that reformulation is becoming more and more of a financial necessity rather than a choice. At

the same time, consumer expectations have changed. In the beverage, dairy, and pastry industries, clean-label positioning, "no added sugar" claims, and diabetic-friendly formulas are now standard expectations rather than niche marketing points. Rather of opposing this change, regulators are supporting it. Proposals to define more precise "low added sugar" claims and assess labelling solutions for non-nutritive sweeteners have been given top priority by food safety regulators. In the meantime, continuous safety reviews of well-known sweeteners continue to improve usage recommendations, especially with regard to specialized processing circumstances like high-heat baking. Reformulation can no longer be viewed as a side activity by NPD teams because of the triple strain of budgetary, consumer, and regulatory issues. A product's long-term viability across markets is increasingly influenced by the choice of sweetener, thus it must be part of the fundamental product strategy.

3. Sweetener Landscape: Technical & Commercial Comparison

A. Artificial Sweeteners

Due to their affordability and processing stability, artificial sweeteners like aspartame, sucralose, and acesulfame potassium (Ace-K) continue to be the mainstay of many reformulation techniques. Because of their strong sweetness in comparison to sugar, they are utilized at extremely low dose levels, have extended shelf lives, and function consistently

in high-heat applications. However, since the International Agency for Research on Cancer (IARC) designated aspartame as "possibly carcinogenic to humans" in 2023, the category has come under increased scrutiny. This classification caused significant market backlash, with some brands quickly reformulating away from aspartame in favor of substitutes like sucralose or natural blends, despite regulatory bodies' insistence that aspartame is safe within current intake limits.

B. Natural high-intensity sweeteners

Clean-label appeal has led to the rapid growth of natural high-intensity sweeteners, primarily stevia and monk fruit. Both provide plant-based, zero-calorie positioning that appeals to customers that are health-conscious. The difficulties are practical rather than legal: stevia, depending on the extract grade, may have a bitter or liquorice-like aftertaste that needs to be carefully blended or masked, and monk fruit extract is far more costly to get than synthetic substitutes. Although they are frequently more expensive than older formulations, more recent stevia extracts (such as Reb M) have been created expressly to lessen this aftertaste.

C. Sugar alcohols (polyols)

High-intensity sweeteners cannot match the bulk, texture, and sugar-like mouthfeel that sugar alcohols (polyols), especially erythritol and xylitol, provide in a formulation. They are thus frequently used as bulking partners in blends. Erythritol and xylitol are both known to cause digestive discomfort at higher intake levels, a long-standing formulation constraint that limits usage thresholds in single-serving products, and recent research has raised concerns about erythritol's possible association with cardiovascular risk markers, prompting closer industry attention.

The trade-offs are evident that artificial sweeteners have the highest level of consumer mistrust but often offer the lowest cost per sweetness unit and the widest regulatory acceptance. Although they cost more and have a more appealing label, natural high-intensity sweeteners need more formulation work. Sugar alcohols meet texture and bulk requirements, but they have tolerance limits and, in the case of erythritol, new safety concerns that are still being investigated.

4. Formulation Challenges & Innovation Responses

In addition to removing sweetness, removing sugar from a formulation also removes structure, browning, moisture retention, and mouthfeel, revealing issues that are rarely resolved by a single replacement. Blends are now the standard in the industry because of this. One ingredient can carry sweetness

while the other rebuilds body and texture when a high-intensity sweetener like stevia is combined with a bulking polyol like erythritol. Suppliers are increasingly packaging this combination as ready-to-use, pre-optimized blends to reduce reformulation delays.

The most enduring sensory obstacles are still bitterness and lasting aftertaste. Bitter-blocking and taste-masking systems employ receptor-level modulation and encapsulation techniques to neutralize off-notes without dulling the overall flavor profile, making flavour modulation technology a key component in the solution. Since many alternative sweeteners linger or come with a delayed sweetness curve, suppliers claim that recreating sugar's "temporal profile" its quick onset and clean, short finish remains one of the most difficult technical goals.

Another level of intricacy is added by shelf-stability. In high-heat applications like baking, where thermal processing can completely change the flavour and stability profile, sweeteners must withstand heat, interact consistently with proteins and acids, and avoid producing new off-notes during processing or storage.

Additionally, these difficulties manifest differently depending on the category. Because there isn't much fat or viscosity in beverages, particularly in clear or high-protein formats, off-notes are clearly visible and need more forceful masking. Rebuilding bulk, browning, and structure becomes the main focus in bakeries; this is frequently accomplished by combining allulose, stevia, and texturizing ingredients with taste modulators. Dairy presents a much more complex problem because sweetness must interact harmoniously with fat, acidity, and fermentation aromas without flattening the overall taste profile of the product.

5. Risk Management: Navigating the Science-Communication Gap

Instead of being a passing trend, conflicting science is now a persistent characteristic of the sweetener category. The tendency to either minimize worries or overcorrect with defensive messaging carries risk when research on aspartame or erythritol yields unclear or

High-intensity sweeteners cannot match the bulk, texture, and sugar-like mouthfeel that sugar alcohols (polyols), especially erythritol and xylitol, provide in a formulation. They are thus frequently used as bulking partners in blends. Erythritol and xylitol are both known to cause digestive discomfort at higher intake levels, a long-standing formulation constraint that limits usage thresholds in single-serving products, and recent research has raised concerns about erythritol's possible association with cardiovascular risk markers, prompting closer industry attention.

contradicting results. Proactive disclosure, which acknowledges that research is ongoing, explicitly states the current regulatory status, and avoids categorical statements of "proven safe" or "risk-free" that may not hold up when new studies are conducted, is a more resilient approach.

Consumer trust studies repeatedly demonstrate that consumers are actively cross-referencing ingredient claims utilizing apps and internet resources, and they are examining labels more carefully than ever before. This implies that errors in message are becoming easier to identify and more expensive when they do. Companies that emphasize ingredient integrity in their communications—explaining not only what is eliminated but also why a substitution was selected—generally do better than those that rely solely on nebulous, unsupported "clean" or "natural" claims.

Transparency should be viewed as a long-term trust asset rather than a one-time crisis response. This lesson applies to all categories. When the next research or regulation change eventually occurs, brands that prepare for inquiries regarding sweeteners and processing are better positioned than those that wait to respond to criticism.

Expect further regulatory tightening in the near future, including more stringent front-of-pack labeling suggestions, continuous safety revaluations of legacy sweeteners, and increased scrutiny of "natural" and "clean label"

claims across several areas. Teams in charge of formulation and messaging will be in the greatest position to safeguard consumer trust and compliance if they keep ahead of these changes rather than responding to them.

6. Conclusion

There isn't a single "best" sweetener; instead, the optimum option relies on the target market, product category, and regulatory exposure rather than the popularity of a particular ingredient. As science and regulations continue to change, today's favored blend may need to be reviewed. What works for a beverage rarely translates cleanly to bakery or dairy. Therefore, developing formulation flexibility supported by teams who monitor new research and regulatory changes as closely as they monitor consumer trends is the strategic priority rather than selecting a winner. Early engagement with ingredient suppliers, as opposed to waiting until a reformulation deadline, gives brands access to co-development help that can prevent costly mistakes later on and shorten timescales.

Author's Bio

Payoshni S. Joshi is a technical writer specializing in the food and beverage industry. She regularly contributes authoritative articles to Food & Beverages Processing magazine, highlighting innovations, best practices, and emerging trends that are shaping the global food and beverage landscape.

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Banana Starch Based Functional Bigel: Good Choice for Fat Replacement in Foods

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Introduction

Rising health concerns associated with the excessive consumption of fats have intensified the search for healthier lipid alternatives in food systems. Although conventional solid fats are essential for providing desirable texture, mouth feel, and structural stability, their direct replacement often leads to compromised sensory and functional quality. This challenge has encouraged the exploration of structured lipid systems that can replicate fat-like behavior while improving nutritional value.

Bigels have recently gained attention as innovative soft materials composed of two gelled yet immiscible phases namely a hydrogel and an oleogel combined into a single biphasic structure. This dual-network system enables the simultaneous incorporation of aqueous and lipid components, offering enhanced mechanical strength, improved rheological behavior, and greater formulation flexibility. The use of natural, food-grade biopolymers further strengthens the applicability of bigels in clean-label and health-oriented foods.

Why bigels?

Replacing solid fats in food formulations frequently results in undesirable changes such as weak texture, poor mouthfeel, and phase separation. Oleogels, while effective in structuring liquid oils, lack the ability to retain water, whereas hydrogels alone fail to reproduce the lubrication and melting behavior of fats. Bigels overcome these limitations by integrating the complementary functionalities of both gel systems.

Banana starch-based bigels show strong potential as substitutes for conventional solid fats due to their ability to replicate fat-like texture and mouthfeel while incorporating healthier oils. The starch hydrogel contributes moisture retention and structural stability, whereas the oleogel phase provides lubrication and melting characteristics. This combination enables significant reductions in saturated fat content in bakery, confectionery, and processed foods without compromising sensory quality. The functional performance of bigels is strongly influenced by their physicochemical and rheological characteristics.

The incorporation of banana starch as the hydrogel matrix could be tried due to its natural abundance, low cost, and functional versatility. Banana starch contributes strong water-binding capacity, elasticity, and structural integrity, which enhance the stability of the biphasic system.

The selection of banana starch based bigels is therefore supported by:

- Their ability to simultaneously structure aqueous and lipid phases
- The potential to significantly reduce saturated and trans fat content
- Improved textural, rheological, and moisture-retention properties
- Compatibility with plant-based and clean-label formulations
- Applicability in functional and nutritionally improved foods

Bigels: Concept and Structure

Bigels, also known as hybrid or biphasic gels, are structured systems composed of two gelled phases typically a hydrogel and an oleogel that coexist within a single matrix. Unlike emulsion gels, where only one phase is structured, bigels exhibit dual gelation, resulting in superior mechanical stability and multifunctionality. These systems are commonly prepared through controlled thermal processing followed by high-shear mixing, allowing the formation of either dispersed or interpenetrating networks. In banana starch based bigels, the starch hydrogel provides hydration, elasticity, and water retention, while the oleogel phase delivers lipid structuring and fat-mimetic properties. This synergistic interaction enables the development of materials with enhanced stability, tunable texture, and broad applicability in food systems.

Components of Bigels

Oleogels

Oleogels are semi-solid systems formed by immobilizing liquid edible oils within a three-dimensional network created by small quantities of oleogelators. This process converts liquid oils into solid-like structures without altering their fatty acid composition, thereby preserving nutritionally beneficial unsaturated fats. Oleogelators may include low-molecular-weight compounds such as beeswax, candelilla wax, rice bran wax, carnauba wax, paraffin wax, fatty acids, fatty alcohols, and monoacylglycerols, or high-molecular-weight materials like ethyl cellulose, hydroxypropyl methylcellulose, and certain proteins such as soy protein isolate and whey protein. Oleogels exhibit desirable properties such as thermoreversibility, oil-binding capacity, and fat-like texture, making them suitable substitutes for conventional solid fats.

Hydrogels

Hydrogels prepared from starch, cellulose, or other polysaccharides. We have trial with such as banana starch, consist of three-dimensional polymeric networks capable of absorbing and retaining large amounts of water. Upon gelatinization, banana starch forms a cohesive and elastic matrix stabilized by hydrogen bonding and molecular entanglement. These hydrogels provide excellent moisture retention, spreadability, and structural support. Although hydrogels alone are limited in delivering hydrophobic

compounds, their combination with oleogels in bigel systems effectively addresses this drawback, enabling multifunctional performance.

Types and Classification of Bigels

Based on the spatial arrangement of the hydrogel and oleogel phases, banana starch-based bigels can be classified into the following categories:

Oleogel-in-Hydrogel (O/H) Bigels

Oleogel droplets are dispersed within a continuous starch hydrogel matrix. This type is widely studied due to its high stability and effectiveness in fat replacement applications. The banana starch network ensures hydration and structure, while the oleogel droplets provide lipid functionality.

Hydrogel-in-Oleogel (H/O)

Starch hydrogel particles are dispersed within a continuous oleogel phase. These systems exhibit stronger fat-like behavior and are suitable for applications requiring enhanced lipid continuity, such as spreads and bakery shortenings.

Bi-continuous Bigels

Bi-continuous bigels consist of interpenetrating networks of both banana starch hydrogel and oleogel phases. These complex systems offer synergistic mechanical and rheological properties but require precise control of formulation and processing conditions.

Applications of Banana Starch-Based Bigels

Fat Replacers in Food products

Banana starch-based bigels show strong potential as substitutes for conventional solid fats due to their ability to replicate fat-like texture and mouthfeel while incorporating healthier oils. The starch hydrogel contributes moisture retention and structural stability, whereas the oleogel phase provides lubrication and melting characteristics. This combination enables significant reductions in saturated fat content in bakery, confectionery, and processed foods without compromising sensory quality. The functional performance of bigels is strongly influenced by their physicochemical and rheological characteristics. Important characterisation parameters include melting point, texture profile, oil-binding capacity, spreadability, viscoelastic behaviour, hardness, and thermal stability.

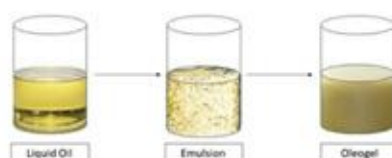
The melting point of bigels can be tailored to mimic conventional fats, providing desirable mouthfeel and controlled melting during consumption. Texture analysis helps evaluate firmness, cohesiveness, adhesiveness,

Properties of different hydrogel

Property	Oleogel-in-Hydrogel (O/H)	Hydrogel-in-Oleogel (H/O)	Bicontinuous Gel
Definition	Oil phase structured within a continuous hydrogel matrix	Water/hydrogel droplets dispersed within a continuous oleogel matrix	Both oil and water phases form interconnected continuous networks
Continuous Phase	Hydrogel (aqueous phase)	Oleogel (oil phase)	Both phases are continuous
Dispersed Phase	Oleogel droplets	Hydrogel droplets	No clear dispersed phase
Appearance	Soft, moist, jelly-like	Greasy, semi-solid, butter-like	Creamy, complex structured gel
Texture	Smooth and elastic	Firm and spreadable	Highly viscoelastic
Water Content	High	Low to moderate	Balanced oil and water distribution
Oil Content	Moderate	High	High in both interconnected phases
Mouthfeel	Refreshing and hydrating	Rich and fatty	Creamy and stable
Mechanical Strength	Moderate	High due to oil network	Very high because of dual network structure
Viscoelasticity	Dominated by hydrogel behavior	Dominated by oleogel behavior	Combined viscoelastic behavior from both networks
Stability	Good water retention but lower oil stability	Better oxidative stability	Excellent long-term stability
Barrier Property	Poor moisture barrier	Good moisture barrier	Improved barrier against both oil and water migration
Release Behavior	Faster release of hydrophilic compounds	Controlled release of hydrophilic compounds	Dual release capability for hydrophilic and lipophilic compounds
Encapsulation Suitability	Suitable for probiotics and hydrophilic bioactives	Suitable for lipophilic compounds	Suitable for simultaneous encapsulation of both compounds
Digestibility	Faster digestion in aqueous environment	Slower digestion due to lipid phase	Controlled and prolonged digestion
Preparation Method	Oleogel dispersed into hydrogel under homogenization	Hydrogel dispersed into oleogel	Simultaneous structuring of both phases
Typical Gelling Agents	Alginate, gelatin, pectin with oleogelators	Wax, monoglycerides with hydrogel particles	Combination of hydrogelators and oleogelators
Thermal Stability	Moderate	Higher thermal stability	Excellent thermal and structural stability
Applications	Functional beverages, desserts, probiotic foods	Spreads, butter substitutes, bakery fillings	Advanced delivery systems, meat analogues, nutraceutical foods
Advantages	Hydrating, biocompatible, easy release	Better lipid protection and texture	Superior stability and multifunctionality
Limitations	Lower oil loading capacity	Limited water incorporation	Complex preparation and higher cost

and spreadability, which are essential for applications such as margarine, shortening, and cream-based products. Rheological properties, including storage modulus (G') and loss modulus (G''), indicate the structural

strength and stability of the gel network. In addition, oil-binding capacity and freeze-thaw stability are important indicators of the ability of bigels to retain oil and maintain structural integrity during processing and



Starch



Hydrogel



Fig : Bigel process image

storage. These properties collectively make banana starch-based bigels promising fat replacers for developing healthier and functionally stable food product.

Delivery Systems for Bioactive Compounds

The biphasic nature of banana starch-based bigels allows simultaneous encapsulation of hydrophilic and lipophilic bioactive compounds. Water-soluble components can be retained within the starch hydrogel, while fat-soluble compounds are incorporated into the oleogel phase. This dual encapsulation enhances protection against degradation and enables controlled release during digestion, making these systems highly suitable for functional food applications.

Meat and Plant-Based Alternatives

In meat products, banana starch-based bigels can partially replace animal fat, leading to reduced saturated fat content while maintaining juiciness, texture, and cooking yield. In plant-based meat analogues, these bigels improve lipid distribution and structural cohesion, addressing common issues such as dryness and poor fat mimicry. The tunable rheology of banana starch bigels allows them to closely resemble the melting and lubrication behavior of animal fats.

3D Food Printing and Structured Foods

Banana starch-based bigels exhibit shear-thinning behavior, shape retention, and rapid structural recovery, making them suitable for 3D food printing applications. Their stability during extrusion and ability to incorporate nutrients support the development of personalized and functional foods with customized texture and composition.

Food Packaging and Edible Coatings

Beyond formulation, banana starch-based bigels have potential in edible coatings and food packaging. The starch hydrogel matrix acts as a moisture barrier, while the oleogel phase reduces oxygen permeability, thereby delaying lipid oxidation and dehydration. Incorporation of natural antioxidants or antimicrobials further enhances shelf life and food safety.

Conclusion

Banana starch-based bigels represent a promising and sustainable approach to fat replacement in food systems by effectively combining the water-binding and structural properties of starch hydrogels with the fat-mimetic behavior of oleogels. The biphasic architecture enables significant reduction of saturated and trans fats while maintaining desirable texture, mouthfeel, and stability. Owing to their versatility, clean-label potential, and functional performance, banana starch-based bigels offer wide applicability in fat-reduced foods, functional products, plant-based alternatives, and emerging technologies such as 3D food printing, making them a valuable platform for next-generation healthy food formulations.

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Sustainable Food Supply Chains

Reducing Carbon, Increasing Resilience

Ritesh Verma



The global food supply chain is one of the most complex systems on the planet. It connects farms, fisheries, food processors, packaging manufacturers, logistics providers, retailers, and finally consumers. While this interconnected system feeds billions of people every day, it also carries a heavy environmental cost. From agricultural emissions and energy-intensive processing to excessive packaging and long-distance transportation, the food supply chain is responsible for nearly one-third of global greenhouse gas emissions. As climate change accelerates and resource pressures intensify, sustainability and decarbonisation are no longer optional goals. They have become urgent necessities.

Decarbonising the food supply chain does not mean slowing growth or compromising food security. Instead, it involves rethinking how food is produced, processed, packed, stored, transported, and consumed, with a strong focus on efficiency, responsibility, and long-term resilience. Across the globe, governments, corporations, startups, and farmers are working together to reduce emissions, conserve resources, and create a food system capable of feeding future generations without harming the planet.

The Carbon Footprint of Food: Understanding the Challenge

The environmental impact of food begins long before it reaches the consumer's plate. Agriculture itself is a major contributor to emissions due to the use of fertilisers, methane released by livestock, land-use changes, and water-intensive farming

practices. Deforestation for agricultural expansion further worsens the situation by reducing carbon sinks that naturally absorb carbon dioxide from the atmosphere.

Beyond farming, food processing adds another layer of emissions through electricity consumption, heat generation, refrigeration, and water usage. Packaging, especially plastic-based and non-recyclable materials, contributes to both carbon emissions and waste pollution. Logistics and cold chain operations, which are essential for preserving perishable food, rely heavily on fossil fuels and energy-intensive refrigeration systems. Food loss and waste, estimated at nearly one-third of all food produced globally, represent a massive waste of embedded carbon, water, and energy.

Addressing sustainability therefore requires a holistic approach that looks at the entire lifecycle of food rather than focusing on a single stage in isolation.

Sustainable Agriculture as the Foundation

Sustainability efforts in the food supply chain must start at the source. Farmers are increasingly adopting climate-smart agricultural practices that improve productivity while reducing environmental impact. Techniques such as precision farming, soil health management, crop rotation, and reduced tillage help lower emissions while enhancing yields.

Precision agriculture, enabled by sensors,

satellite data, and data-driven analytics, allows farmers to use fertilisers, water, and pesticides more efficiently. By applying inputs only where needed and in the right quantities, emissions are reduced while soil and water resources are protected. Regenerative agriculture goes a step further by focusing on restoring soil health, increasing biodiversity, and improving carbon sequestration in farmland.

Livestock farming, often criticised for its methane emissions, is also undergoing transformation. Improved feed formulations, better manure management, and selective breeding are helping reduce emissions per unit of output. At the same time, alternative proteins, including plant-based, fermented, and cultivated meat, are emerging as complementary solutions that can significantly lower the carbon footprint of protein consumption.

Energy-Efficient and Low-Carbon Food Processing

Food processing facilities are among the most energy-intensive parts of the supply chain. From heating and cooling to drying, freezing, and sterilisation, energy consumption is unavoidable. However, decarbonisation is increasingly possible through smarter energy use and cleaner technologies.

Many food manufacturers are transitioning to renewable energy sources such as solar, wind, and biomass to power their operations. On-site solar installations and renewable energy purchase agreements are becoming more common, particularly in regions with supportive policy frameworks. Energy-efficient machinery, heat recovery systems, and process optimisation technologies further reduce overall energy demand.

Emerging processing technologies such as high-pressure processing, microwave-assisted processing, pulsed electric fields, and cold plasma offer alternatives to conventional thermal methods. These technologies reduce energy consumption while preserving nutritional quality and extending shelf life, which in turn helps reduce food waste. Water efficiency has also become a priority area. Closed-loop water systems, advanced filtration technologies, and wastewater reuse help reduce freshwater consumption and minimise environmental discharge from food processing plants.

Sustainable Packaging and Material Innovation

Packaging plays a vital role in protecting food, extending shelf life, and ensuring safety. However, it is also one of the most visible sustainability challenges in the food industry. Traditional packaging materials, especially

single-use plastics, contribute significantly to carbon emissions and environmental pollution.

The industry is now shifting towards lightweight, recyclable, compostable, and bio-based packaging materials. Paper-based packaging, mono-material plastics, biodegradable films, and plant-based polymers are gaining traction across food categories. Packaging designs are also becoming more efficient, using less material while maintaining strength, barrier properties, and product protection.

Sustainability in packaging is not only about material choice. Design for recyclability is equally important. Eliminating unnecessary layers, improving labelling clarity, and aligning packaging formats with local recycling infrastructure are essential steps toward building a circular packaging economy. Reusable packaging models, refill systems, and returnable transport packaging are also being explored, particularly in food service and institutional supply chains.

Smart packaging solutions such as freshness indicators and QR-based traceability are further supporting sustainability by reducing food waste and improving supply chain transparency.

Decarbonising Food Logistics and Cold Chains

Transportation and storage are critical links in the global food supply chain, especially as food increasingly travels across borders. At the same time, logistics is a major source of emissions due to diesel-powered trucks, ships, and energy-intensive cold storage facilities.

Decarbonising food logistics involves a combination of strategies. Route optimisation using digital tools helps reduce fuel consumption by minimising delays and empty miles. Shifting freight from road to rail or sea, where feasible, significantly lowers emissions per tonne of food transported. The gradual adoption of electric, hybrid, and alternative fuel vehicles is transforming last-mile and regional food distribution.

Cold chain sustainability is gaining particular attention. Refrigeration accounts for a large share of energy use and often relies on refrigerants with high global warming potential. New-generation refrigeration systems using natural refrigerants, combined with energy-efficient insulation and smart temperature monitoring, are helping reduce both emissions and operating costs. Localised and decentralised food systems are also contributing to lower transport emissions. Shorter supply chains, regional sourcing, and

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urban food hubs reduce dependency on long-distance transportation while strengthening local economies.

Digitalisation and Transparency for Sustainable Decision-Making

Digital technologies are becoming powerful enablers of sustainability and decarbonisation across the food supply chain. Blockchain-based traceability systems allow companies to track products from farm to fork, providing transparency on sourcing practices, carbon footprint, and ethical standards. This transparency supports regulatory compliance while building trust with increasingly conscious consumers.

Data analytics tools help companies measure emissions accurately and identify hotspots for improvement. Carbon accounting platforms enable food businesses to set realistic reduction targets and monitor progress over time. Internet of Things devices provide real-time insights into energy use, temperature control, and logistics efficiency, enabling faster and more informed decision-making.

Digital platforms are also encouraging collaboration across the value chain. By sharing data and aligning sustainability goals, suppliers, manufacturers, and retailers can work together to reduce overall emissions instead of shifting the burden from one stage to another.

Reducing Food Loss and Waste

Food loss and waste represent one of the most avoidable sources of emissions in the food system. When food is wasted, all the resources used to produce, process, package, and transport it are wasted as well. Reducing food waste is therefore one of the most effective strategies for decarbonisation.

Improved demand forecasting, better inventory management, and smarter packaging solutions help reduce waste at processing and retail levels. Technologies

that extend shelf life, such as modified atmosphere packaging and advanced preservation methods, play a critical role. At the consumer level, awareness campaigns, portion control, and clearer date labelling help reduce household food waste. Surplus food redistribution, composting, and the conversion of food waste into energy or animal feed further contribute to circularity and emissions reduction.

The Role of Policy, Collaboration, and Consumer Awareness

Government policies and regulations are key drivers of sustainability in the food supply chain. Carbon pricing, renewable energy incentives, packaging regulations, and food waste reduction targets are encouraging companies to take meaningful action. International sustainability frameworks and certification standards are also helping align practices across regions and markets.

Collaboration across the value chain is essential. No single company can decarbonise the food system on its own. Partnerships between farmers, processors, packaging suppliers, logistics providers, technology companies, and retailers are necessary to scale sustainable solutions. Consumers are also playing an increasingly important role. Growing demand for sustainably sourced, responsibly packaged, and transparently produced food is influencing brand strategies and investment decisions. Sustainability is becoming a core expectation rather than a niche preference.

Building a Resilient and Low-Carbon Food Future

The journey toward sustainability and decarbonisation of the global food supply chain is complex, but it is also filled with opportunity. Innovation, technology, and collaboration are enabling the industry to reduce its environmental impact while improving efficiency, resilience, and profitability.

By reimagining agriculture, transforming processing and packaging, decarbonising logistics, and reducing waste, the food industry can move toward a system that nourishes both people and the planet. The decisions made today will determine not only the environmental footprint of food but also the long-term stability of global food security. Sustainability is no longer a distant vision. It is becoming the foundation of the modern global food supply chain, shaping how food is produced, delivered, and consumed in a rapidly changing world.

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Shri Vibracion Technologies Celebrates 9th Foundation Day & Launches Experience Center



Shri Vibracion Technologies Pvt. Ltd. celebrated its 9th Foundation Day with the inauguration of its new Experience Center, marking nine years of innovation, quality, customer trust, and engineering excellence. The event was attended by the company's employees, customers, partners, and well-wishers who have contributed to its growth.

Over the past nine years, the company has expanded from serving Indian manufacturers to supporting customers in global markets, providing customised material handling and processing solutions for the snack food, frozen food, pharmaceutical, chemical, food processing, packaging, and other industries. As it enters its tenth year, Shri Vibracion Technologies plans to strengthen its presence in Europe, the Middle East, and other

international markets.

The newly launched Experience Center enables customers to explore and evaluate a wide range of equipment, including vibrating conveyors, electromagnetic vibrating feeders, screening systems, motorised conveyors, belt conveyors, nubbin graders, length graders, size grading systems, and customised material handling solutions. The facility also offers live product trials, allowing customers to test their own materials on the machines while the company's engineering team recommends suitable solutions based on specific production requirements. According to the company, the Experience Center is designed to help customers make informed investment decisions while enhancing the overall customer experience.

acceptability of chicken sausages, supporting evidence-based recommendations for the processed poultry industry in India.

As part of the collaboration, CLFMA of India will provide a research grant of ₹5 lakh to GADVASU for the execution of the six-month project. The study will be carried out under the leadership of Dr Nitin Mehta, Professor-cum-Head, Department of Livestock Products Technology, GADVASU, with technical oversight from the university's research team.

Speaking on the collaboration, Divya Kumar Gulati, Chairman, CLFMA of India, said, "The Indian poultry processing industry is witnessing rapid growth, driven by changing consumer preferences and increasing demand for safe, nutritious, and convenient protein products. As the industry evolves, standards and regulations must be backed by robust scientific evidence. Through this partnership with GADVASU, CLFMA aims to support research that will generate credible data on moisture content in chicken sausages, helping to strengthen technical understanding while ensuring product quality, consumer confidence, and industry competitiveness."

Rakesh Swami, Group President-Corporate Affairs, Godrej Industries Group and Management Committee Member, CLFMA of India, said the partnership between industry, academia and government will strengthen India's animal protein value chain through science-based standards, enhancing product quality, safety and consumer confidence. The three-phase study will establish baseline compositional data of broiler chicken from different regions of India, evaluate chicken sausage formulations with varying moisture levels, and develop evidence-based recommendations on optimal moisture content for nutrition, processing efficiency, product stability and consumer acceptance. A consumer survey will also assess market acceptance of the different formulations.

CLFMA of India Partners with GADVASU in Ludhiana to Undertake Scientific Study on Moisture Content in Chicken Sausages



The Compound Livestock Feed Manufacturers Association (CLFMA) of India has signed a Memorandum of

Understanding (MoU) with Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana, to undertake a comprehensive scientific research project titled "Comprehensive Evaluation of Moisture Content on the Technical Stability and Sensory Acceptability of Chicken Sausages in India." The research initiative aims to generate scientific evidence on the impact of moisture content on the quality, safety, nutritional integrity, technical stability and consumer

Dr. Swarn Singh Randhawa, Director Research, GADVASU, noted that industry-academia collaborations help address scientific challenges for the benefit of consumers. Vice-Chancellor Dr. J.P.S. Gill added that the research will generate scientific data to support evidence-based food standards, innovation, quality assurance and informed policy decisions for India's poultry processing sector. The collaboration underscores the shared commitment of CLFMA of India and GADVASU to advancing scientific research, fostering innovation, supporting sustainable growth in poultry processing, and strengthening India's animal agriculture ecosystem.

Alfa Laval deepens its commitment to the global food industry with new Food & Pharma Division



Alfa Laval has reorganized its former Food & Water Division into the Food & Pharma Division, reinforcing its focus on the food industry while expanding its pharmaceutical capabilities. The company said the new structure enhances customer alignment through dedicated market-

focused operations and significantly increases investment in research and development. Food remains the core business of the new division, covering sectors such as dairy, beverages, edible oils, meat and fish processing, as well as emerging areas including alternative proteins and

fermentation-based production. Sammy Hulpiau, President of Alfa Laval Food & Pharma Division, said the reorganization will enable the company to better support food and beverage manufacturers with greater innovation and stronger collaboration.

The division's portfolio includes separation, heat transfer and fluid handling technologies, along with recent innovations such as hygienic WideGap heat exchangers, Foodec Oil Plus decanters, PureFerm separators, and the Alfa Laval Fermentation System. According to Christian Thomsen, Business Unit President, Process Engineering Solutions, the company aims to help customers improve uptime, increase yields, reduce water and energy consumption, and develop new production methods.

To further strengthen innovation, Alfa Laval announced that a 1,200 sq. m. Food Application & Innovation Centre will open in Copenhagen, Denmark, in spring 2027. The facility will complement the company's existing Application & Innovation Centre in Kolding, Denmark, and technology laboratory in Flemingsberg, Sweden, providing a collaborative hub for developing next-generation food processing solutions.

PepsiCo India inaugurated its state-of-the-art flavour manufacturing facility in Ujjain



PepsiCo India has inaugurated its state-of-the-art flavour manufacturing facility in Ujjain, Madhya Pradesh, with an investment of ₹1,266 crore, one of the company's largest manufacturing investments in the country. The 22-acre facility, inaugurated virtually by Dr. Mohan Yadav, Chief Minister of Madhya Pradesh, alongside Eugene Willemssen, CEO – International Beverages, PepsiCo; Jagrut Kotecha, CEO – India and South Asia, PepsiCo; and Even Norton, GM and SVP, PepsiCo Global Concentrate Solutions, marks PepsiCo's second flavour manufacturing plant

in India and the ninth globally. The facility will manufacture beverage concentrates and is expected to generate around 500 direct and indirect employment opportunities, supporting industrial development and ancillary business growth across central India.

The Ujjain plant forms part of PepsiCo's ₹5,700 crore investment commitment in India through 2030, aimed at expanding manufacturing capacity, strengthening supply chains, enhancing sustainability, and supporting long-term growth under the 'Make

in India', 'Viksit Bharat 2047', and 'In India, For India' initiatives. PepsiCo also continues its agricultural engagement in Madhya Pradesh through its collaborative farming programme involving more than 2,000 farmers for the sustainable sourcing of chip-grade potatoes. Speaking at the inauguration, Dr. Mohan Yadav said the investment reflects growing confidence of global companies in Madhya Pradesh and will create employment, strengthen the state's industrial ecosystem, and contribute to economic growth. Eugene Willemssen described India as a strategic growth market for PepsiCo, stating that the new facility reinforces the company's long-term commitment while bringing together global manufacturing, technology, and sustainability capabilities. Jagrut Kotecha said the plant reflects PepsiCo's 'Partnership of Progress' and 'In India, For India' strategy, highlighting its role in advancing beverage manufacturing innovation and expanding the company's agricultural footprint in the state.

Developed under PepsiCo's Winning with pep+ (PepsiCo Positive) philosophy, the facility will operate entirely on renewable electricity, feature zero liquid discharge technology, advanced water-efficiency systems, and aims to replenish 100% of the water used in its operations, supporting the company's sustainable and future-ready manufacturing goals.



Cosmo Films launches Transparent Antifog Bio-Degradable Films for fresh food packaging applications

The advanced BOPP film combines antifog performance, optical clarity and high seal strength with oxo-biodegradable properties

Cosmo Films, a global leader in specialty films for packaging, lamination, labelling and industrial applications, today announced the launch of its new Transparent Antifog Bio-Degradable Film, an advanced packaging film engineered to address the performance and sustainability requirements of fresh food packaging applications.

The newly developed film is a co-extruded, biaxially oriented polypropylene (BOPP) film, featuring heat-sealable and treated surfaces on both sides. Designed with oxo-biodegradable properties, the film is engineered to biodegrade within approximately 2 to 2.5 years under suitable conditions, offering an advanced material solution for packaging applications requiring high transparency, sealing performance and effective fog management.

A key technical feature of the film is its cold and hot antifog performance on one side, which helps minimise moisture-induced

fogging and maintain package visibility across varying temperature conditions. The other side offers enhanced printability and good ink adhesion, supporting high-quality printing and branding requirements. The film also delivers excellent machinability and optical properties, along with high heat-seal strength, high hot-tack strength and a low seal initiation temperature. These properties enable efficient processing on packaging lines while supporting reliable seal integrity for fresh produce and other temperature-sensitive applications.

Commenting on the launch, Mr. Kulbhushan Malik, Global Business Head, Cosmo Films said, "Fresh food packaging requires films to perform across multiple parameters, from optical clarity and antifogging to seal integrity and machinability. With the Transparent Antifog Bio-Degradable Film, we have focused on engineering these functional properties into a single BOPP film while incorporating oxo-biodegradable

characteristics. The development reflects our continued focus on application-led innovation and creating specialised film solutions aligned with evolving packaging requirements."

The Transparent Antifog Bio-Degradable Film has been specifically developed for the packaging of fresh-cut vegetables, salads and meat, where visibility and effective antifog performance are critical to product presentation. Its optical clarity and processing characteristics also make it suitable for flower wrapping applications.

The launch further strengthens Cosmo Films' specialty films portfolio and reflects the company's continued emphasis on R&D-led innovation and sustainable film solutions. Cosmo Films continues to develop high-performance films engineered around specific end-use applications and evolving requirements across the global packaging industry.

Amcor partners with Kelpi to advance next-generation barrier materials for fiber packaging



Amcor, a global leader in developing and producing responsible packaging solutions, today announced a collaboration with U.K.-based startup Kelpi to explore next-generation coating technologies designed to enhance the performance and sustainability of packaging materials.

The partnership with Kelpi supports Amcor's broader innovation strategy focused on identifying and advancing solutions that enable more sustainable packaging while maintaining high functional standards. Amcor's research and development teams are currently evaluating Kelpi's proprietary coating technology platform, a bio-based¹ seaweed material designed to deliver barrier

performance and compatibility with recycling streams for fiber-based packaging.

By evaluating breakthrough bio-based coating technologies, Amcor aims to further expand the options within its AmFiber™ fiber-based solutions platform to continue meeting demanding application requirements such as barrier performance, high running speed and circularity. The potential benefits of using such bio-based coatings include reduced reliance on fossil fuel-derived feedstocks and greater use of renewable resources, which may contribute to a lower carbon footprint.

"This collaboration reflects how we are advancing our material innovation pipeline, and it supports the Ellen MacArthur Foundation's call for accelerated innovation in paper-based flexible packaging²," said Peter Ettridge, Director, Research and Development, AmFiber™, Amcor. "We're excited by the potential of Kelpi's technology, which

combines processability, gas and moisture barrier performance, and paper recyclability."

"Partnering with companies like Kelpi is a key part of how we bring new technologies into our innovation ecosystem," said Frank Lehmann, Vice President, Corporate Venturing and Open Innovation, Amcor. "Its innovative approach to leveraging nature-sourced materials that won't compromise packaging performance is promising, and we're excited to explore opportunities to scale the technology within our global packaging portfolio." By combining Kelpi's technology with Amcor's global research and development capabilities and scale, the companies aim to evaluate commercially viable, scalable solutions for customers across various consumer goods sectors, supporting a circular economy for packaging.

¹ Based on Dec. 2024 Measurelabs biogenic carbon testing report.

² Paper-Based Flexible Packaging: The role it could play in tackling small-format flexible plastic pollution in markets with high leakage rates, Ellen MacArthur Foundation, March 2026.

TotalEnergies Corbion launches compostable foam alternative to PS extrusion foaming (XPS)



TotalEnergies Corbion announced the commercial launch of Luminy® FOAM 50F, a high melt strength PLA grade designed for extrusion foamed packaging applications. Developed for trays used in fresh food products, like meat and fish, and food service packaging such as clamshells and bowls, the material delivers the performance of conventional extruded polystyrene (XPS) while providing a lower-carbon, circular alternative.

As packaging producers face increasing regulatory pressure to phase out polystyrene in food applications and with restrictions expanding globally, the market is actively seeking alternatives that combine environmental benefits with industrial scalability. Luminy® FOAM 50F addresses this need with a bio-based, industrially compostable material that enables a practical transition without disrupting established production processes. Luminy® FOAM 50F is engineered as a drop-in replacement for PS, allowing converters to run it on existing XPS extrusion lines with comparable throughput and minimal modification.

"With polystyrene bans accelerating, this is one of the first solutions positioned as a true industrial-scale replacement, not a niche material" said Laurent Daligault, Global Packaging Segment Leader at TotalEnergies Corbion. "Luminy® FOAM 50F enables converters and brand owners to adopt a truly sustainable drop-in solution to XPS, both in terms of processing and product functionality. It is also good for our planet, with our sugarcane-based PLA delivering at least a 70% reduction in carbon footprint compared to XPS foam parts. We look forward to supporting our customers globally, both

commercially and technically, as they advance their sustainability ambitions."

The material combines performance and sustainability characteristics that have historically been difficult to achieve in XPLA foam packaging. It offers comparable density and functional properties to XPS while maintaining processing efficiency on standard equipment. At the same time, it is biobased, industrially compostable, recyclable, and free from styrene, PFAS, and persistent microplastics.

Luminy® FOAM 50F's high melt strength enables stable foam production without the need for extra additives, chain extenders, or reactive processing. This allows manufacturers to create low-density foam structures with uniform cell morphology, closely matching the performance required for demanding applications such as fresh protein packaging.

"This development reflects our commitment to sustainable innovation," said Hao Ding, Global Marketing Director at TotalEnergies Corbion. "We continue to focus on creating high-performance materials that are better for both people and the planet."

Luminy® FOAM 50F is available for commercial orders globally. It is FDA and Korean Food Contact approved and can be used in countries following the FDA or Korean regulation. For other countries it can be used for non-food applications. TotalEnergies Corbion provides technical support to assist customers with implementation.

www.totalenergies-corbion.com

Graphic Packaging Enters Uncoated Recycled Paperboard Market with Launch of PaceSetter Ridgeline



Graphic Packaging Holding Company (NYSE: GPK), a global leader in sustainable consumer packaging, today announced the launch of PaceSetter Ridgeline™, marking the company's entry into the uncoated recycled paperboard (URB) market. The URB offering — a high-performing solution for folding cartons, laminations, edge protectors, tubes and cores, and other specialty purposes — positions Graphic Packaging to serve a broader spectrum of paperboard and consumer packaging customers.

"PaceSetter Ridgeline extends our recycled paperboard platform to new markets and customers, further diversifying our portfolio to include industrial applications," said Robbert Rietbroek, president and chief executive officer at Graphic Packaging. "This new uncoated grade gives customers a fit-for-purpose recycled paperboard option backed by the scale, reliability and manufacturing capability they expect from Graphic Packaging."

Made from 100% recycled fiber, with at least 45% post-consumer recycled content, PaceSetter Ridgeline is available in 14- to 30-point calipers and produced at Graphic Packaging's state-of-the-art Waco, Texas, paperboard mill. The Waco facility enables seamless transitions between coated and uncoated recycled paperboard, giving the company flexibility to respond quickly to shifts in customer demand. Its advanced technology also supports sheet squareness, color consistency, quality assurance and converting performance across high-volume applications.



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