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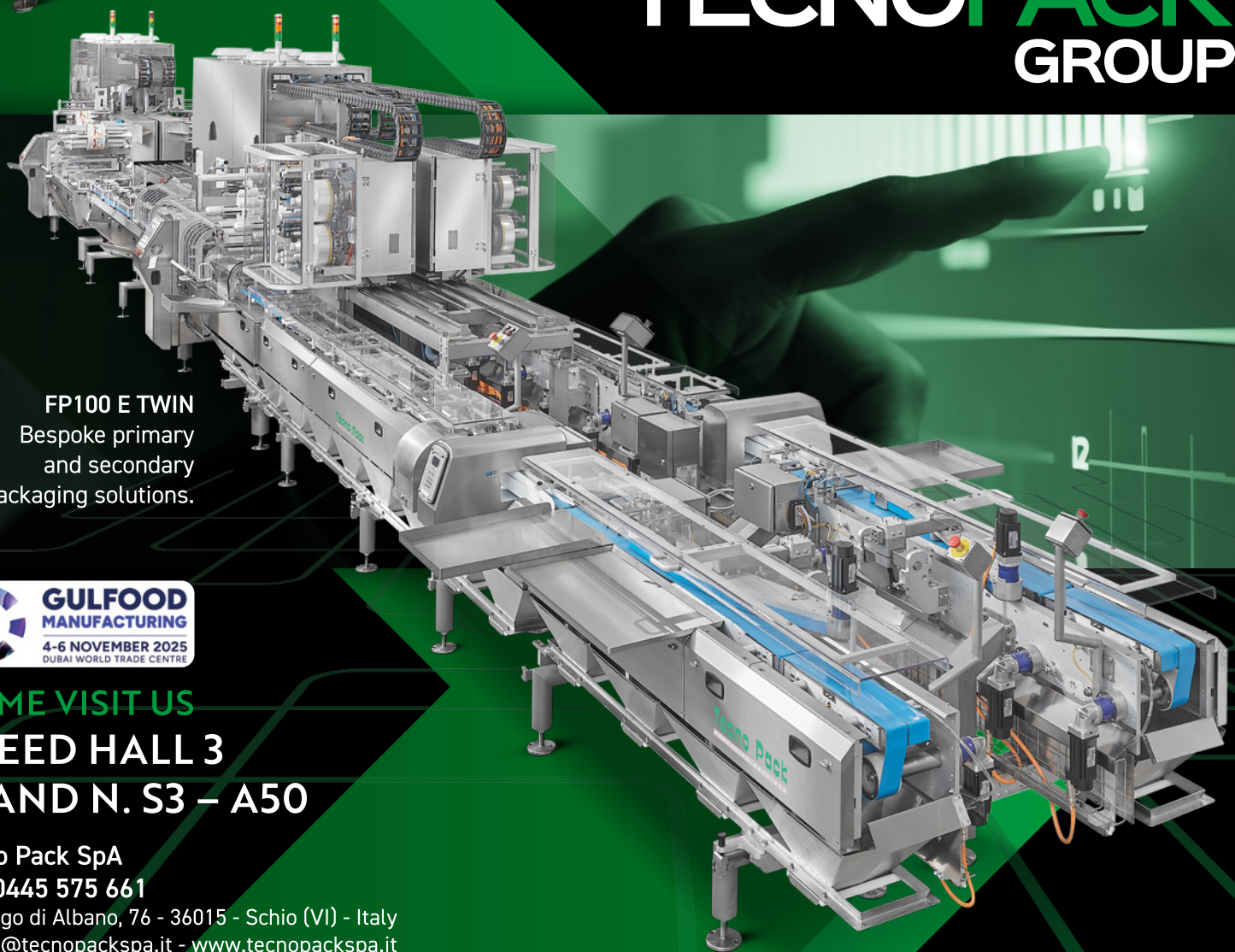
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DEPARTMENTS

3 **PRODUCT TRENDS** - Cocoa and Chocolate Market Global Forecast to 2030 - Dairy Alternatives Market worth $43.6 billion by 2028 - Meat Product Market Projected to Hit $68.9 Billion by 2028 - Alternative Proteins Fuel a $25.2 Billion Global Market by 2029

20 **FOOD PROCESSING** - Artificial Intelligence drives performance in sweets and snacks production - From request to complete line: how a custom confectionery system is created - Pizza or Pinsa? With Albaequipment lines, it is possible to produce both without compromises - Isochoric cooling process preserves dairy cream stability - Isochoric freezing for improving raw milk and carrot juice safety - Optimising ohmic baking of wheat bread - Particle Size Distribution Model for Optimizing Coffee Grind

30 **PACKAGING TRENDS** - Food and beverage metal cans market to reach $70.72 billion by 2029 - Oriented PE consumer packaging film, a confused market seeking clarity - Evaluation of modified atmosphere packaging for purple passion fruit - Innovative active films with essential oils for meat - Controlling beef microbial spoilage with diacetyl-based active packaging sachet - Quality changes of pork ham slices packed using various methods - Geometry of containers and heating of foods in autoclave

40 **PACKAGING EQUIPMENT** - End-of-line packaging automation by $2.4 billion in five years - Robotics and vision systems in perfect harmony - MEGAPOWER Silcoat: Megadyne's silicone belt that revolutionises food packaging - Sarp: leading technology for pouch pasteurization and cooling - Tecno Pack: Innovation, Sustainability, and Precision Engineering - Empresas Polar and SMI: investing to satisfy a growing market - Automation of Packaging Lines: Key Challenges and Solutions

52 **NUTRITION** - Agar-based emulsion gel as a pork fat substitute in sausage - Effects of aging and repeated freeze-thaw cycles on beef sirloins quality - Development of a fermented pistachio-based beverage - Physically modified plant oils as alternatives to palm fat - Production of clean label starch as a xanthan gum substitute - Use of beetroot color in ice cream manufacturing - Maize-based snacks with white grape pomace - Dry cacao pulp in chocolate bars: a sustainable, nutrient-rich sweetener - Green coffee extract as an antioxidant in mayonnaise - Butter aroma compounds in plant-based milk alternatives

60 **RESEARCH** - The impact of controlled fermentation temperature on properties of cacao - Preserving and re-using a whole microbial cheese community - Application of multi-frequency ultrasonic thawing on pork - Microwave-assisted extraction optimization in cocoa beans - Production of pasta filata style cheese - Recovery of milk fat from waste ice cream - Cryogel addition effect on ultrasound-assisted thawing of pork meat - Ultrasound-induced gelation of proteins in plant-based milk - Accelerated pork salting using needle electrode-derived pulsed electric fields - Ohmic pasteurization of probiotic chocolate dairy desserts - Optimization of spray dried yogurt and its application in functional cookies - Ultrasound-assisted extraction of chickpea proteins - Microwave treatments to reduce browning of fresh-cut artichokes - The impact of ambient temperature on arabica coffee fermentation

70 **NEWS** - Solids Parma returns: the reference event for the bulk materials Industry - Healthy, organic, sustainable: the future of eating out of home is at SANA Food in Bologna - International events in Italy

72 **COMPANY INDEX**



NOVEMBER 2025 - issue 111

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Cocoa and Chocolate Market Global Forecast to 2030

According to the **MarketsandMarkets** report, the **cocoa and chocolate market** is projected to grow from USD 23.69 billion in 2025 to USD 28.24 billion by 2030, at a CAGR of 3.6% from 2025 to 2030

The demand for sweet yet healthy treats is driving the market, with sustainable sourcing, organic formulations, and ethical certifications being prioritized. Cocoa beans of traceable origin, sugar-reduced chocolates, and plant-based options are now the overriding factors distinguishing a manufacturer.

Advancements in technology, such as blockchain-enabled supply chain visibility, AI-based demand forecasting, and automated production systems, are being leveraged to streamline operations and meet compliance requirements. Sustainability continues to be a core focus as companies initiate programs to introduce biodegradable wrappers, recyclable packaging films, and low- emission production processes. E-commerce and direct-to-consumer channels' availability, particularly in emerging markets, have fast-tracked product reachability. Brands utilize digital channels to engage consumers with personalized offers, such as chocolates that provide additional nutrients or mood-enhancing ingredients.

Factors such as urbanization, rising middle-class incomes, and changing food preferences are expected to drive significant growth in market share in both developed and developing countries. Investments in innovative products, transparent sourcing, and environmentally responsible manufacturing.

Global Cocoa and Chocolate Market Dynamics

Rising demand for functional and premium chocolate offerings

The cocoa and chocolate market is experiencing significant growth due to an increasing demand for premium and functional chocolates. Consumers are



now more inclined to choose products that offer added health benefits, such as high cocoa content, low sugar levels, and plant-based alternatives. Dark chocolate is particularly popular, as it is recognized for its heart health benefits.

In May 2024, Barry Callebaut launched the "Next Generation Cacao" range, which features nutrient-dense formulations designed to meet the demand for wellness-focused chocolates. The growth of the urban middle class and rising disposable incomes in emerging economies are also contributing to increased spending on premium and artisanal chocolates. This trend has been supported by innovations in probiotic and high-protein chocolate variants that cater to health-conscious consumers. Additionally, demand is expected to rise in online and specialty retail formats, as brands strive for functional positioning and transparency in their cocoa sourcing.

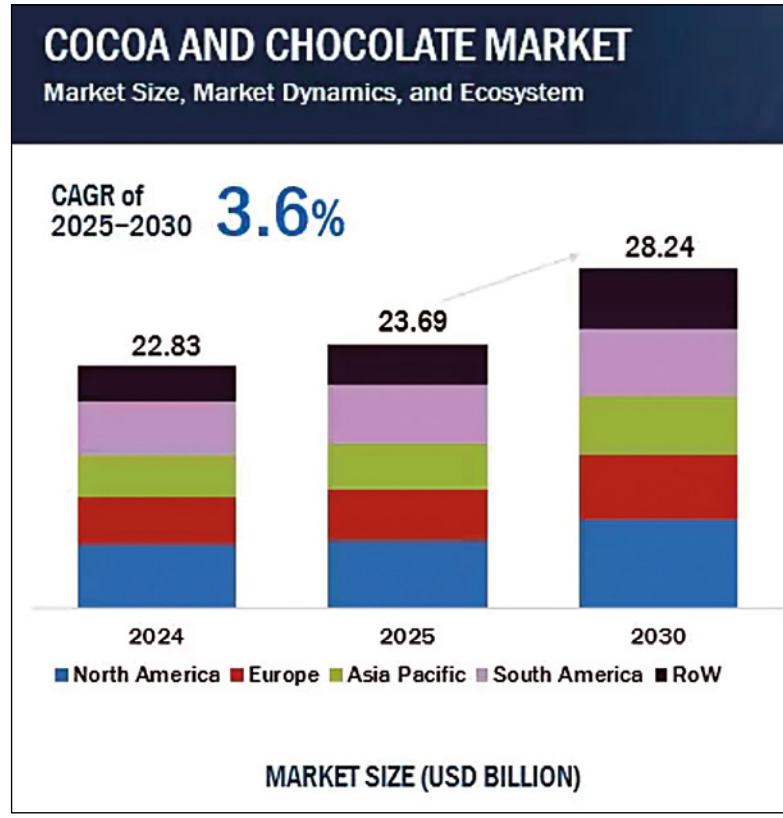
Cocoa price volatility affecting manufacturer margins

The primary constraint in the cocoa and chocolate market is the price fluctuation of cocoa beans, which often impacts manufacturers' cost structures. Geopolitical factors and climate-induced crop failures contribute to these fluctuations, along with supply chain disruptions in producer countries, particularly Côte d'Ivoire and Ghana. In April 2024, it was reported that cocoa prices surged to a 46-year high due to drought conditions and disease outbreaks affecting West African harvests. Consequently, procurement costs have risen for both major companies and mid-tier chocolatiers. As a result, cocoa import-dependent businesses must either raise their prices or risk becoming uncompetitive.

Price instability also hinders the development of long-term sourcing strategies and limits options for creating affordable products. While large corporations can mitigate risk through futures contracts and diversified sourcing, smaller companies often lack such resources. Therefore, cocoa price volatility remains a significant challenge, severely affecting profitability, production planning, and supply chain resilience across the entire value chain.

Expansion in sustainable and traceable supply chains

Ethically sourced and environmentally sustainable chocolate is increasingly being demanded, thus presenting new growth opportunities. Traceability, deforestation-free sourcing, and fair labor practices are being pressed upon by consumers and regulators. In June 2025, Mondelez International extended its Cocoa Life program into India and Southeast Asia to enhance sustainability and traceability at the farm level. This goes beyond the purely ethical supply bias and is well in line with forthcoming EU due diligence legislation for traceable and sustainable agricultural imports.



On the other hand, technological advancements in digital traceability, including blockchain and QR code packaging, render it possible for brands to be transparent with regard to their supply chain in real time, from bean to bar. These innovations, in turn, bolster brand credibility and consumer trust, especially in the premium segments. The brands investing in verifiable sustainability certifications (such as Rainforest Alliance and Fairtrade) and digital sourcing transparency will undoubtedly take the larger market share. This support around the ethics of supply chains, therefore, opens the gates

for large strategic investments as well as green investment funding and partnerships.

Global Cocoa and Chocolate

Market Ecosystem Analysis

The cocoa and chocolate value chain immerses a large number of players spanning from established giants down to the newest breed of innovators. Regulatory authorities and associations, including the International Cocoa Organization (ICCO), the European Food Safety Authority (EFSA), and the US FDA, ensure quality, safety, and sustainability in the cocoa value chain. The role of distribution is played by retail store chains, both online and offline to ensure consumer accessibility. Putting these together constructs a dynamic market landscape bearing significant innovation, compliance with regulations, and growing ends of consumer reach.

The cocoa liquor segment is estimated to lead the market

Cocoa liquor is anticipated to lead the cocoa type segment during the forecast period, driven by its central role in the formulation of chocolate products. As an essential raw ingredient for dark, milk, and premium chocolates, cocoa liquor (also known as chocolate liquor or cocoa mass) provides the core flavor and texture attributes preferred in high-quality offerings. The rising global consumption of dark and artisanal chocolates – particularly in North America and Europe – is directly influencing the increased demand for cocoa liquor. In May 2025, Barry Callebaut AG announced the expansion of its cocoa liquor production facility in Belgium to meet growing demand from European gourmet chocolate brands. The expansion includes automation, enhanced fermentation controls, and sustainable sourcing verification for beans, aimed at improving traceability and flavor consistency. Additionally, many manufacturers are emphasizing single- origin cocoa liquor in premium product lines to cater to consumers seeking authenticity and ethical sourcing.

Cocoa liquor's usage extends beyond confectionery, with increasing applications in cosmetics and functional food products, thereby enhancing its market relevance. The segment benefits from its integral role in flavor development, ongoing product premiumization trends, and alignment with sustainability-driven sourcing strategies. These factors collectively support its dominant position during the forecast period. By chocolate type, the dark chocolate segment is expected to witness the highest CAGR during the forecast period.

The dark chocolate segment is projected to register the highest CAGR

This growth is attributed to rising consumer awareness of its possible health benefits, which include antioxidant-rich properties, improved cardiovascular health, and comparatively less sugar content than milk chocolate. The associated trend is further supported by the demand for clean-label, vegan, and high-cocoa-content products across North America, Europe, and Asia Pacific.

The rise in demand for dark chocolate for snacking and gifting can be balanced by the appeal of healthy indulgence, especially among urban millennials and health-conscious consumers. Market presence is being boosted by online retail and premium chocolate gifting. These factors drive dark chocolate to be the fastest-growing segment in that category.

North America is estimated to lead the market

North America is expected to maintain its dominant position in the cocoa and chocolate market during the forecast period, as strong consumer demand exists for premium, organic, and functional chocolate products. The US especially sees sustained consumption throughout multiple formats, from traditional confections to fortified snacks and beverages enriched with cocoa derivatives.

Additionally, the rise of e-commerce platforms and online retail channels such as Amazon and Walmart.com has enabled niche and artisanal brands to achieve faster product reach and visibility. Consumers are increasingly looking for products that offer health benefits, sustainability, and indulgence, with a growing preference for dark chocolate, low-sugar options, and clean-label products. With established market players, strong distribution networks, and increased investments in product differentiation, North America is leading growth in the global cocoa and chocolate market.

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Dairy Alternatives Market worth $43.6 billion by 2028

According to the **MarketsandMarkets** report, the global **dairy alternatives market** is estimated at USD 27.0 billion in 2023 and projected to reach USD 43.6 billion by 2028, growing at a CAGR of 10.1% during the forecast period. The rising demand for plant-based alternatives underscores a global shift toward healthier, more sustainable dietary choices.

In recent years, the global food industry has witnessed a significant shift in consumer preferences, with a growing demand for dairy alternatives. This trend reflects changing consumer attitudes toward health, sustainability, and ethical considerations. As more people seek to reduce or eliminate dairy products from their diets, the market for dairy alternatives has experienced exponential growth. One of the primary drivers behind the surge in demand for dairy alternatives is the increasing focus on health and wellness. Many consumers are becoming more health-conscious and are looking for options that align with their dietary preferences and restrictions. Dairy alternatives, such as almond milk, soy milk, and oat milk, are often perceived as healthier choices due to their lower saturated fat content and absence of cholesterol. Additionally, some dairy-free options are fortified with vitamins and minerals, making them attractive alternatives for those seeking to maintain a balanced diet. Lactose intolerance is another factor



contributing to the popularity of dairy alternatives. A significant portion of the global population is lactose intolerant, meaning they have difficulty digesting lactose, the sugar found in dairy products. For these individuals, dairy alternatives provide a solution, allowing them to enjoy milk-like products without discomfort or digestive issues. Moreover, dairy allergies are becoming more prevalent, further driving the demand for plant-based milk and dairy substitutes.

The rising demand for dairy alternatives is a multifaceted phenomenon driven by health-consciousness, environmental concerns, ethical considerations, and accessibility to a variety of innovative products. As this trend continues to gain momentum, the dairy alternatives market is likely to evolve even further, with increased investment in research and development, more plant-based product offerings, and a broader consumer base. Whether for health, ethical, or environmental reasons, dairy alternatives are transforming the way we think about and consume dairy products, reflecting a dynamic shift in the global food industry.



Consumers are increasingly showing a preference for vegan food options

The growth of the dairy alternatives market is primarily driven by the global shift towards vegetarian and flexitarian diets. These dietary preferences have gained significant popularity, influenced by various factors such as concerns about animal welfare, environmental issues, and personal health. Veganism has emerged as a lifestyle choice that abstains from consuming animal-derived products, including dairy. The increasing worldwide condemnation of animal cruelty has further boosted the demand for dairy substitutes. Many consumers view a vegan diet as a healthy choice and opt for dairy alternatives like soy milk, almond milk, rice milk, and other plant-based options instead of traditional dairy milk.

Significant growth in the vegan population has been observed in major economies like the United States and the United Kingdom. Consumers in developed nations embrace plant-based milk as it offers energy, health benefits, aids in weight management, and enhances the taste of food. According to The Vegan Society, avoiding meat and dairy consumption plays a crucial role in reducing the environmental impact, particularly concerning carbon emissions.

Currently, the livestock industry contributes an estimated 18% to total greenhouse gas emissions across the five major sectors for greenhouse gas reporting. Within the agricultural sector, farmed animals are responsible for nearly 80% of all emissions. This environmental concern has prompted environmentally conscious consumers to shift towards dairy alternatives.

In 2021, The Vegan Society recorded 16,439 products bearing The Vegan Trademark, with over 82% of these registrations occurring in the past five years. The Vegan Trademark is now recognized in 87 countries globally, and more than half of the registered products come from companies located outside the UK. Given the rapid growth of the vegan population, numerous dairy manufacturers are transitioning towards producing plant-based milk products, which is expected to have a positive impact on the plant-based beverages market.

The issue of allergies among soy food consumers

In the realm of dietary choices, where people often make decisions based on health considerations and ethical values, the issue of allergen cross-contamination has emerged as a significant challenge within the dairy alternatives market.

As more consumers opt for plant-based milk substitutes due to health, environmental, or lifestyle reasons, addressing the prevalence of food allergens and sensitivities has become crucial. Allergen cross-contamination, especially involving common allergens like nuts or soy, presents substantial risks for individuals with allergies or sensitivities. This situation calls for increased awareness and proactive measures throughout the industry. Food allergies are immune responses triggered by specific proteins in food, affecting a substantial portion of the population. Nuts and soy are among the most prevalent allergens, capable of causing severe reactions in susceptible individuals, ranging from mild hives to life-threatening anaphylaxis. Many dairy substitutes, including soy milk, soy-based cheese, and soy-based yogurt, contain soy proteins that can induce allergic reactions. While soybean oil and soy lecithin were initially considered safe for those with soy allergies, it's now recognized that these products may still contain trace amounts of soy protein, potentially leading to allergic responses. Given that numerous dairy alternatives are manufactured in facilities that also handle allergens like nuts or soy, the risk of cross-contamination exists at various stages of production, including sourcing, processing, and packaging.

In recent years, the prevalence of food allergies has risen, becoming a significant concern for both consumers and food manufacturers. According to the Food Allergy Research & Education Organization in the United States, soy ranks among the top eight major food allergens responsible for most serious food allergy reactions in the country. Soybeans are packed with essential nutrients such as vitamins, minerals, isoflavones, and proteins. However, soy also contains anti-nutritional components that can lead to health problems, including soy allergies that manifest as itching and hives. Additional symptoms include gas, bloating, and damage to the intestinal tissue. These factors are anticipated to pose challenges to the dairy alternatives market in the foreseeable future, as soy protein serves as a primary source for producing dairy alternatives.

Opportunities: Changes in lifestyles of consumers

With the global population on the rise, placing additional strain on already limited resources. Escalating energy prices and increasing raw material expenses have a direct impact on food prices, which in turn affects individuals with lower incomes. This stress on the food supply is further compounded by a scarcity of water, particularly prevalent in regions such as Africa and Northern Asia. Additionally, the Asia Pacific region offers cost advantages in terms of production and processing. The combination of high demand and cost-effective production is a significant advantage for dairy alternative suppliers and manufacturers as they target this market.

In response to rapidly evolving lifestyles, people are increasingly gravitating towards nutritious and healthier food options. The distinction between fast food and unhealthy junk food is expected to become more pronounced as consumers actively seek convenient yet health-conscious choices. Identifying naturally high-nutritional-value products represents a significant opportunity for suppliers and manufacturers in this evolving landscape. The factors fueling



the demand for dairy alternatives in these economies are as follows:
Rapid urbanization
Rise in disposable income

Limited availability of raw materials

The increasing rates of deforestation in developing nations have led to a shortage of essential raw materials for dairy alternatives like soy, almond, and rice. Additionally, the extremely cold climatic conditions experienced in countries such as the UK, France, and Spain pose challenges to the cultivation of agricultural crops. Soy milk is derived from whole soybeans or full-fat soy flour, almond milk is created from ground almonds and is devoid of lactose and cholesterol, and oat milk, a lactose-free alternative, is naturally derived from oats, grains, and beans. The scarcity of these agricultural raw materials imposes constraints on European manufacturers, limiting their ability to produce alternative dairy beverages.

The setting up of many industries in developing countries such as China and Australia have diminished the availability of agricultural land. This creates a scarcity of raw materials and prevents the production of dairy alternative products.



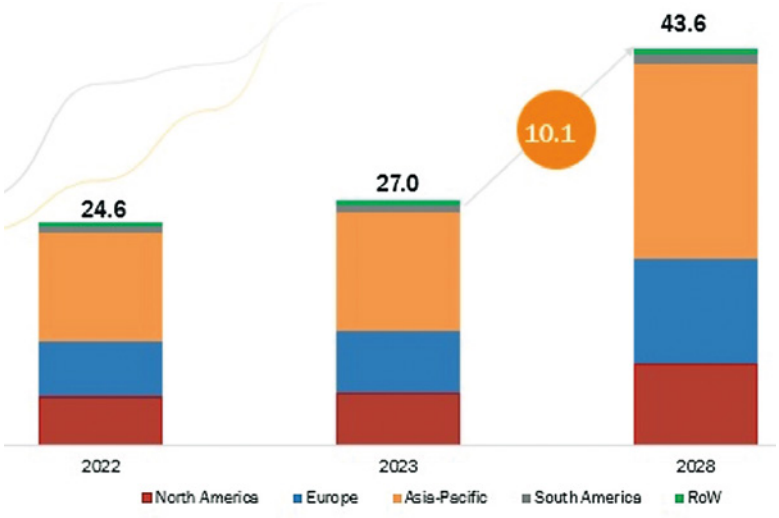
The soy is estimated to account for the largest market share

Soy-based dairy alternatives are considered efficient substitutes for dairy products and occupy a significant share of the dairy alternatives market. The widespread popularity and increasing consumption of soy-based products can be attributed to their exceptional nutritional value. These products serve as abundant sources of proteins and calcium, making them highly regarded as excellent dairy substitutes, especially for those who are lactose intolerant. Furthermore, soy-based products do not contain casein, a common allergen found in many dairy items.

Soy milk, which is available in a variety of flavors and types, offers consumers a wide range of options to choose from. It is typically derived from soybeans or soy protein isolate, with thickeners and vegetable oils often added to enhance taste and consistency. Soy milk finds its best application in savory dishes, coffee, and cereal, where it serves as a suitable replacement for cow's milk. For reference, a one-cup (240 ml) serving of unsweetened soy milk contains approximately 80-90 calories, 4-4.5 g of fat, 7-9 g of protein, and 4 g of carbohydrates. In terms of nutrients, soy milk closely mirrors cow's milk with a similar protein content but only half the calories, fats, and carbohydrates.

However, it's worth noting that soy milk derived from soybeans is not recommended for individuals with FODMAP intolerance or those in the elimination phase of the low-FODMAP diet. FODMAPs are short-chain carbohydrates naturally present in some foods that can lead to digestive discomfort such as gas and bloating.

Soy milk also boasts isoflavones, natural antioxidants that set it apart from other milk alternatives. Isoflavones have been associated with a reduced risk of heart disease, and studies suggest that consuming at least 10 mg of isoflavones per day can lead to a 25% reduction in breast cancer recurrence. A typical serving of soy milk contains roughly 25 mg of isoflavones, with genistein being the most abundant and biologically active isoflavone found in soybeans. Additionally, soy proteins offer protective and therapeutic benefits against various diseases. Soy-based foods are also rich sources of phytochemicals like phytosterols, recognized for their cholesterol-lowering properties.



Dairy alternatives market global forecast to 2028.

Dry soybeans contain about 40% protein, 20% oil, 35% carbohydrate, and 5% ash. In addition to lactose and cholesterol-free properties, soymilk is also a good source of essential amino acids and high-quality protein, potassium, and vitamin B, which are required for the growth of consumers. Lactose-free, cholesterol-free, high nutritious content, high digestibility, and low cost are reported or claimed benefits of soy milk. Owing to these health benefits, soy milk has been used as a functional ingredient in preparing processed foods. Soy-based cheese and frozen desserts are also much in demand. Soy-based products are also rich in fiber, which helps deal with gastrointestinal problems.

The milk of the dairy alternatives market is anticipated to dominate the market

Factors supporting the popularity of dairy-free milk are health concerns related to lactose intolerance and the hectic lifestyles of the working middle-class population, which encourage them to use convenience products for on-the-go consumption to save time. Since health and convenience are prioritized by consumers while making a beverage choice, companies have diversified their beverage offerings with products containing almond milk, coconut milk, and soymilk, along with other non-dairy ingredients and alternatives derived from hemp, oats, or flax.

Plant-based milk has become increasingly popular with consumers because it is perceived as a healthier substitute for traditional cow's milk. Many people are opting for plant-based milk due to health considerations, particularly if they have lactose intolerance or dairy allergies. Plant-based milk options are often viewed as a better choice for health-conscious individuals because they typically contain lower levels of saturated fats and may be enriched with essential vitamins and minerals.

Plant milk offers a diverse range of flavors and varieties, catering to different consumer preferences. Almond milk, soy milk, oat milk, and coconut milk each have their unique taste profiles and textures. This variety appeals to consumers seeking novel flavors and textures in their dairy alternatives, enhancing the overall culinary experience.

The Asia Pacific market is projected to dominate the market

The Asia-Pacific region is witnessing an increasing demand for fortified nutritional food and beverage products due to busy lifestyles and rising disposable incomes. Within this trend, the adoption of dairy alternatives is expected to grow at a faster rate due to consumer preferences. The region's higher economic power is likely to boost the consumption of affordable and abundant soymilk. Food manufacturers are introducing various forms of soymilk to cater to the growing consumer interest in healthy beverages and pasteurized soymilk as dairy substitutes, offering unique flavour options.

This focuses on the study of major countries in the region, including Japan, Australia, China, and India. Key market players in this area include Sanitarium Health & Wellbeing Company, Freedom Foods Group Ltd., Vitasoy International Holdings Limited, and Purebates. The dairy alternatives industry in the Asia-Pacific region is expanding, driven by changing consumer lifestyles. The dairy alternatives market in this region is currently undergoing significant changes due to urbanization, dietary diversification, and increased foreign direct investment in the food sector. Additionally, higher income levels, the rapid growth of the middle-class population, heightened consumer awareness of health and fitness, and the demand for nutritional and health-conscious products present promising growth opportunities in the region's food sector.

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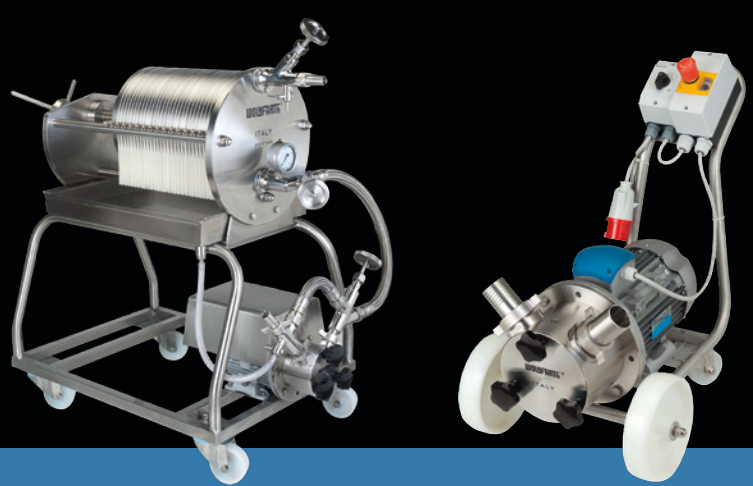
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Meat Product Market Projected to Hit $68.9 Billion by 2028

According to the **MarketsandMarkets** report, the global **meat products market** is estimated at USD 44.3 billion in 2023 and is projected to reach USD 68.9 billion by 2028, at a CAGR of 9.2% during the forecast period. The global market for meat products is a dynamic and diverse sector within the food industry, covering a range of items such as beef, poultry, pork, lamb, and processed meats. In recent times, there has been a consistent uptrend in the demand for meat products, spurred by various factors, and there are no indications of this trend slowing down.

A primary catalyst for this surge in demand is the continuous growth of the world's population, particularly in emerging markets. The expanding population, coupled with increasing disposable incomes, has led to a rise in the consumption of meat as a primary source of protein. Urbanization is another influential factor, transforming dietary patterns as more individuals migrate to urban areas, resulting in a preference for processed and convenient meat products to align with busy lifestyles. Global rises in income levels have prompted consumers to seek higher-quality meat products, driving the demand for premium and specialty options, such as organic and grass-fed meat. Shifting consumer preferences towards healthier, protein-rich diets have spurred interest in lean meats and alternatives, including plant- based options such as tofu and plant-based



burgers. Moreover, ethical concerns regarding animal welfare and environmental impact have influenced preferences towards meat products sourced from humanely and sustainably raised animals. A noteworthy example is Cargill, Incorporated (US), which, in collaboration with the China Animal Health and Food Safety Alliance (CAFA), expanded its product range in China by introducing new Sun Valley Raised Without Antibiotics (RWA) chicken products in March 2021.

Additionally, the expansion of the foodservice industry, globalization, and advancements in meat processing and packaging have all contributed to the escalating demand for meat products. The evolving landscape of this market is marked by a broad array of choices, and the industry's future appears promising, with ongoing innovations and increasing consumer awareness of health and environmental concerns expected to play pivotal roles in shaping its trajectory. The demand for protein, particularly sourced from animals, has consistently been high due to global meat consumption. This demand for protein from animal meat and products is anticipated to persist in the coming years, showing continued growth. According to the OECD FAO Agricultural Outlook 2021-2030, the global consumption of meat proteins is projected to increase by 14% by 2030. Consequently, the demand for meat and meat products is robust and displays no indications of slowing down in the immediate future.



Global meat products market Dynamics

Rising Demand for Meat-based Convenience Foods

The trend of urbanization, marked by the increasing migration of individuals from rural to urban areas, has significantly impacted the meat products market. Notably, the convenience associated with processed and pre-packaged meat items plays a crucial role in driving market growth. Urban lifestyles, characterized by fast-paced routines and limited time for traditional food preparation, make these products appealing due to features like pre-cutting, marination, and cooking convenience. Moreover, the compact living spaces and on-the-go lifestyles in urban settings enhance the attractiveness of these products, requiring minimal kitchen equipment and aligning with fast and portable food preferences. The diverse culinary landscape in cities, reflecting various cultures and cuisines, contributes to the demand for processed meats that accommodate multicultural tastes. Additionally, the assurance of food safety and quality addresses concerns of urban consumers who may lack access to fresh and locally sourced meats.

In summary, the convenience offered by processed and pre-packaged meat products is a key driver of market growth in urban areas, meeting the diverse needs and preferences of the urban population.

Restraints: Growing Trend of Veganism

The surging popularity of veganism is exerting a constraining impact on the meat products market, driven by a confluence of factors such as evolving consumer preferences, heightened concerns for

health and the environment, and an increasing focus on ethical and animal welfare considerations.

Consumers, motivated by the perceived health benefits, environmental sustainability, and ethical apprehensions about animal treatment, are progressively choosing plant-based alternatives over conventional meat products.

Government regulations and subsidies that endorse plant-based foods, coupled with advancements in high-quality meat substitutes, further contribute to this transformative trend.

Market competition, media influences, and the escalating healthcare costs associated with meat-centric diets also play pivotal roles in steering consumers away from traditional meat consumption. While veganism may not entirely eliminate meat consumption, it is anticipated to result in a substantial decline in the demand for meat products, prompting the meat industry to adapt by offering more sustainable and ethically sourced options. The shift towards veganism reflects a broader societal consciousness about the impact of dietary choices on personal health, the environment, and animal welfare. This trend is not only driven by individual choices but also by systemic changes, including government policies and advancements in food technology.

As consumers become more informed and conscientious, the meat industry is compelled to reevaluate its practices and offerings to align with the growing demand for sustainable and ethical food options. This shift underscores a significant transformation in the way we perceive and consume food, emphasizing a more holistic and mindful approach to our dietary habits.

Technological Advancement in Meat Processing Industry

Technological progress is playing a pivotal role in transforming and advancing the meat industry, driving its growth and evolution. These innovations are significantly improving product quality, extending shelf life, and minimizing waste.

The use of modern meat processing equipment allows for precise and controlled methods, ensuring consistent cuts that meet high standards of taste and quality. This not only reflects the industry's commitment to safety and regulatory standards but also contributes to consumer satisfaction. In terms of packaging, advancements such as Modified Atmosphere Packaging and vacuum sealing create controlled environments that enhance the shelf life of meat products, addressing concerns about food waste and promoting sustainability. Additionally, waste reduction efforts are being supported by advanced processing equipment, which maximizes meat utilization and minimizes trimmings and byproducts that would otherwise be discarded.

Innovations in packaging materials also contribute to eco-friendly practices by minimizing excessive packaging. Operational efficiency is a notable outcome of integrating technology into the meat industry.

Automation and robotics are becoming increasingly prevalent in meat processing facilities, streamlining operations, increasing productivity, and reducing labor costs. Automated systems for cutting, trimming, and portioning not only improve efficiency but also ensure product consistency and reduce the risk of human error.

Moreover, technological innovations enable traceability and quality control through the use of data, barcoding, and RFID systems, allowing real-time monitoring and tracking of products throughout the supply chain, thereby enhancing safety measures and regulatory compliance.

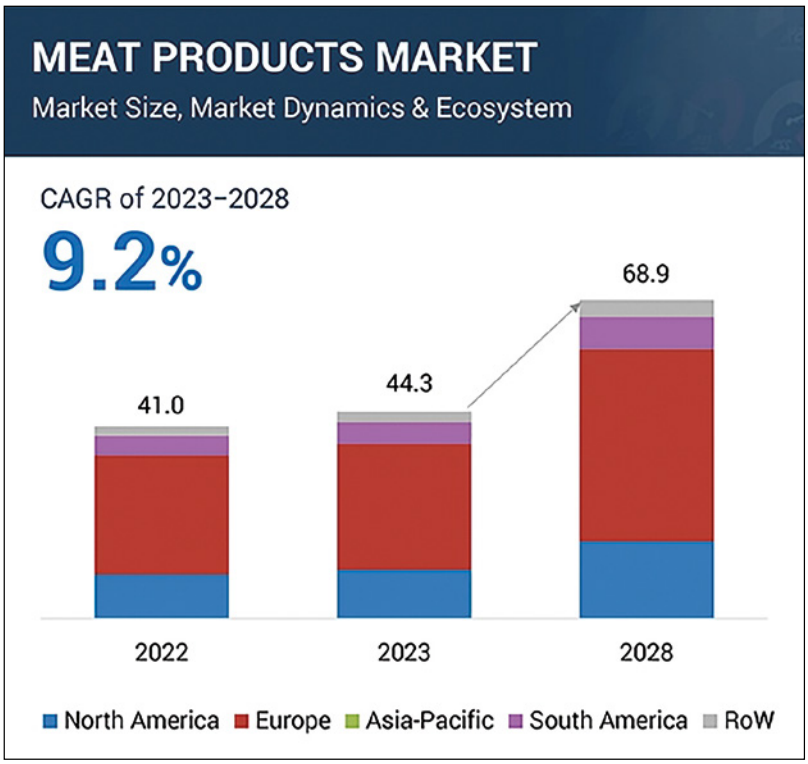
Sustainability is a central focus in the integration of technological advancements within the meat industry. The emphasis on waste reduction, quality improvement, and the adoption of energy-efficient equipment contributes to minimizing the industry's environmental footprint.

In conclusion, the meat industry's embrace of new technologies positions it well to meet changing consumer demands, reduce environmental impact, and maintain a competitive edge in the market.

Challenges: Fluctuation in Feed Prices and Labour Costs

Volatility in feed prices and labor costs presents substantial challenges to the meat products market, as evidenced by recent developments in Kazakhstan's poultry industry. The escalation of feed costs, influenced by global dynamics in the grain market, has had a profound effect on domestic poultry and egg production. Nearly 70% of the production costs for poultry and eggs are attributed to feed expenses, and these costs have surged significantly over time.

For instance, data from Poultry World in 2019 indicated that the price of wheat was USD 109 per tonne, whereas the current price has surged to USD 237 per tonne. Similarly, corn prices have increased by 50%, and soybean meal has experienced a threefold price hike, rising from USD 213 to USD 639 per tonne in Kazakhstan. These fluctuations have created difficulties for poultry farmers in maintaining reasonable price levels for national consumption.



The industry's heavy dependence on imports for various resources, including live birds, veterinary drugs, and production equipment, exacerbates the challenge. The weakened exchange rate of the Kazakh tenge has further increased the cost of these imports. Consequently, poultry farmers are grappling with heightened production costs, necessitating government consideration of state support and subsidies to alleviate the impact of expensive feed on the industry's sustainability.

This situation underscores the meat products market's susceptibility to feed price fluctuations and emphasizes the importance of implementing strategic measures to stabilize the sector and ensure the affordability of meat products for consumers.

Global meat products market Ecosystem Analysis

Processed is one of the types that Accounted for the Highest Market Share in 2022. The surging demand for processed meat products, encompassing cured, dried, roasted, smoked, and fermented varieties, can be attributed to a confluence of factors reshaping consumer behavior.

In today's fast-paced lifestyles, characterized by time constraints and hectic schedules, the convenience offered by processed meats has become increasingly appealing. These products require minimal preparation, aligning seamlessly with the preferences of busy individuals and professionals seeking quick and easy meal solutions. Moreover, the diverse flavors and textures achieved through curing, smoking, and fermentation processes cater to the evolving culinary tastes of a more adventurous and discerning consumer base.

The globalization of food culture has also played a pivotal role, exposing consumers to a broader array of culinary traditions and fostering a demand for unique and exotic flavors. As disposable incomes rise globally, consumers are more inclined to opt for convenience foods, with processed meats fitting the bill as a ready-to-eat or easy-to-prepare option. Despite health considerations, the indulgent and savory qualities of processed meats continue to attract consumers, prompting manufacturers to adapt by introducing healthier formulations.

In essence, the burgeoning demand for processed meat products reflects a dynamic interplay of convenience, culinary diversity, economic trends, and evolving consumer preferences in the contemporary food landscape.

Europe Region Holds the Largest Share

The European market offers significant business prospects for meat product manufacturers, driven by the increasing emphasis on health awareness in the region. This heightened awareness has led to a surge in demand for meat products, supported by a growing number of manufacturers entering the market and introducing new products. Factors such as sustainability concerns and a heightened focus on health practices are key drivers of this shift.

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Alternative Proteins Fuel a $25.2 Billion Global Market by 2029

According to the **MarketsandMarkets** report, the global **protein alternatives market** is valued at USD 15.7 billion in 2024 and is projected to grow to USD 25.2 billion by 2029, registering a CAGR of 9.9% over the forecast period. This surge is powered by a blend of rising health awareness, growing environmental consciousness, and ethical concerns about animal welfare. Consumers are increasingly shifting away from traditional animal-based proteins toward more sustainable sources such as plant-based proteins, insect-derived options, and algae. Advances in food technology have been pivotal, allowing producers to develop protein alternatives that replicate the taste, texture, and nutrition of conventional meats – broadening appeal across mainstream markets.



Global Protein Alternatives Market Dynamics

Increasing Demand for Alternate Protein

The increasing global population underscores the necessity for alternative protein sources. Over the past decade, significant efforts have focused on developing proteins from non-traditional crops and livestock. This trend is particularly noticeable in Europe and North America, where consumer in-

terest and investment in alternative proteins have surged. The conventional sources of animal protein like pork, beef, and chicken are projected to be insufficient to meet future demands, creating opportunities for the expansion of the insect protein market. In addition to proteins and fats, insects are valued for their rich mineral and vitamin content. Among younger demographics, particularly in sports nutrition, insect proteins, such as cricket flour, are gaining popularity and are being incorporated into various nutritious food products. For instance, startups like Next Step Foods in the UK produce cricket protein bars like "Yuana" available in multiple flavors.

The shift to alternative proteins also promises environmental benefits, notably in reducing greenhouse gas emissions compared to traditional meat production, as highlighted by the World Economic Forum in 2019. Moreover, adopting alternative proteins addresses diet-related health concerns in developing countries and promotes healthier lifestyles in developed regions such as North America and Europe. These areas have already embraced alternative protein sources such as edible insects, plant-based meat, plant protein ingredients, and cultured meat. Industry experts predict significant market growth potential for these products, with cultured and plant-based meat alone expected to see over 40% growth in the coming years.

In 2022, a study funded by the European Regional Development Fund revealed that 22% of UK consumers preferred alternative protein sources over meat, with the younger demographic showing an even higher preference exceeding 25%. These trends underscore the growing market opportunities in the insect protein sector.



Microbial Risk and Allergic Reactions

Food allergies are widespread globally and have seen increased prevalence. While insects offer nutritional benefits, their introduction into food and feed poses potential allergic risks for both animals and humans. Due to the novelty of incorporating insects into diets, understanding and treating these allergies is currently limited, thereby raising concerns for consumers. Risks associated with insect consumption include possible contamination by chemicals like heavy metals and microbiological agents. Moreover, certain insects can elicit allergic reactions through ingestion, inhalation, direct contact, stings, and bites. Cross-reactivity with allergens from related foods such as crustaceans and environmental allergens like dust mites further complicates the allergy landscape associated with insect consumption.

Research from the University of Nottingham's School of Biosciences and Department of Nutritional Sciences highlights that in North-eastern Thailand's Isan region, approximately 7.4% of individuals reported adverse reactions to edible insects, with 14.7% experiencing multiple reactions. Notably, 46.2% of those affected had pre-existing food allergies exacerbated by insect consumption. Gastrointestinal symptoms such as diarrhea and vomiting were commonly reported. This underscores the significant allergy-related challenges facing insect protein adoption, particularly in Western cultures.

Changes in consumer lifestyles

The global population's expansion is placing heightened strain on limited resources, with escalating energy prices and raw material expenses impacting food costs, particularly affecting lower-income demographics. Additionally, the strain on food resources is being intensified by water scarcity, notably prevalent across Africa and Northern Asia. Within the Asia Pacific region, there exists a cost advantage in terms of both production and processing, fostering high demand and offering favorable conditions for dairy alternative suppliers and manufacturers to target this market.

As lifestyles evolve rapidly, there's a noticeable shift towards more nutritious and health-conscious food options. The distinction between fast food and junk food is anticipated to grow, with consumers increasingly seeking quick yet wholesome alternatives. Recognizing naturally rich nutritional products presents a significant opportunity for suppliers and manufacturers to meet evolving consumer preferences.

Furthermore, the rise in disposable incomes is driving demand for convenient, healthy, and highly nutritious products across Asia Pacific nations. Emerging economies within the region present substantial opportunities for growth within the protein alternatives market.

Replicating meat and dairy textures challenges due to consumer expectations

Developing plant-based proteins that convincingly replicate the taste, texture, and mouthfeel of traditional meat and dairy products is a multifaceted challenge in the protein alternatives market. Meat and dairy products are deeply ingrained in culinary cultures worldwide, and consumers have well-established expectations regarding their sensory experiences. Mimicking the savory umami flavor, juicy texture, and tender bite of meat, for example, requires intricate formulation of plant proteins and other ingredients. Achieving a similar experience to dairy products like cheese or yogurt involves not just replicating taste but also mimicking the creamy texture and richness that dairy fats impart.

Texture plays a crucial role in consumer acceptance of plant-based alternatives. The fibrous structure of meat or the smooth consistency of dairy products is often difficult to replicate with plant-derived ingredients alone. Innovations in food science have led to the development of techniques such as extrusion, fermentation, and blending of proteins to enhance texture and mouthfeel. However, balancing these efforts with clean label requirements and natural ingredient preferences adds another layer of complexity. Moreover, ensuring that these products remain stable during cooking or processing without compromising taste or texture is a continuous challenge that requires ongoing research and development.

Based on nature, the organic sub segment is estimated to grow at the fastest CAGR

Consumers are increasingly turning towards plant-based and organic protein sources as they become more health-conscious and environmentally aware. This shift is driven by concerns over animal welfare, sustainability, and the desire for cleaner, healthier eating options. Organic protein alternatives, such as plant-based meats, dairy substitutes, and protein-rich grains like quinoa and lentils, are gaining popularity due to their perceived health benefits and minimal environmental impact. Companies in this sector are innovating rapidly to meet rising demand, offering a diverse range of products that cater to various dietary preferences and nutritional needs. As a result, the protein alternatives market is not only expanding in size but also evolving in terms of product offerings and market reach.



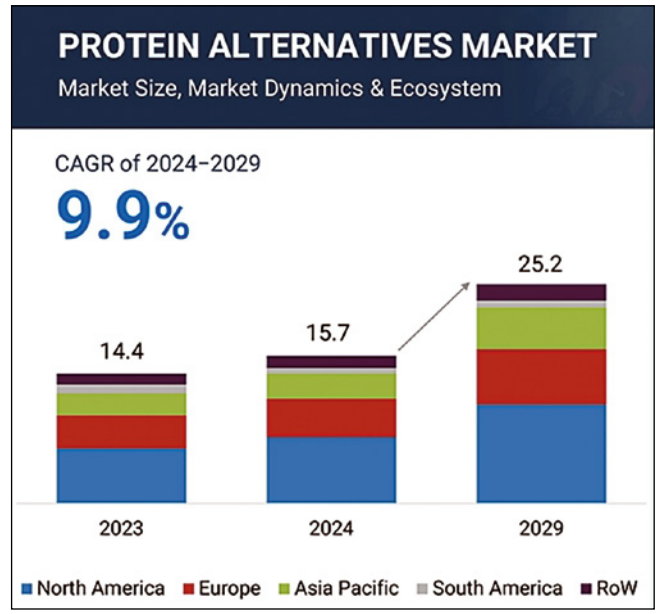
Moreover, the growth in the protein alternatives market is bolstered by changing consumer behaviors and preferences towards more sustainable lifestyles. As awareness of climate change and resource depletion increases, consumers are seeking out products that align with their values of sustainability and ethical sourcing. Protein alternatives not only offer a viable substitute to traditional animal-based proteins but also often boast certifications that ensure they are produced using environmentally friendly practices. This growing market trend is attracting investment from both established food companies and startups alike, driving further innovation and market expansion. Overall, the organic nature of the protein alternatives market reflects a broader societal shift towards healthier, more sustainable food choices, shaping the future landscape of the food industry.

The feed application in the protein alternatives market is forecasted to register the most significant CAGR

The demand for protein alternatives in animal feed is steadily increasing, reflecting the rising consumption of various products in developed countries. North America and Asia Pacific are key players in both livestock production and feed consumption. While plant-based sources have been utilized in the food industry for some time, they have typically been processed and used in a relatively basic protein form. However, there is a noticeable trend towards the development of higher-quality protein-based feeds, such as isolates, indicating an improvement in feed quality. Insect proteins, increasingly favored in poultry and aquaculture feeds, and microbial proteins, widely integrated into compound premixes to enhance nutritional profiles, are gaining traction. This shift towards alternative protein sources in feed applications is driven by mounting concerns about sustainable agricultural practices aimed at reducing the environmental impact of future food production.



In March 2022, Global Bugs' (Thailand) successful partnership with Smart Vet Group (Thailand) highlighted a strategic move towards meeting the rising market demand for alternative protein sources in pet food. By focusing on formulating and producing pet foods and supplements containing whole roasted crickets and cricket powder, they are tapping into a growing trend where consumers are increasingly seeking sustainable and nutritious options for their pets. This collaboration not only underscores the potential of insect-based proteins in the pet food industry but also demonstrates a commitment to innovation and meeting evolving consumer preferences.



Asia Pacific region holds the largest share

The protein alternatives market in the Asia Pacific region is witnessing rapid expansion, driven by heightened consumer awareness of health benefits, immunity enhancement, and environmental sustainability. This shift towards protein sources beyond traditional animal products underscores a growing recognition of the health advantages associated with plant-centric diets, including lower risks of chronic illnesses and bolstered immune systems. Concurrently, rising concerns over environmental sustainability, such as the impact of animal agriculture on carbon emissions and land use, are prompting consumers to adopt plant-based alternatives. This evolving trend is bolstered by advanced food technologies that offer a diverse array of plant-based protein products tailored to meet the region's diverse culinary preferences. Consequently, the Asia Pacific region is emerging as a significant force in shaping the global protein alternatives market, poised for sustained growth and continuous innovation in the foreseeable future.

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Artificial Intelligence drives performance in sweets and snacks production

"In recent years, buzzwords like Big Data, Cloud, AI, and smart sensors have defined digitalisation. ProSweets Cologne 2026 will show how these technologies are transforming automation and quality assurance in the sweets and snacks industry."

The manufacturers of sweets and snacks are facing a variety of challenges. New packaging lines must be quickly ready to operate so that production schedules can be maintained. At the same time, the output quantities must be achieved stably, and overall system effectiveness must be permanently assured, without malfunctions or down times. This is joined by the necessity to be able to adapt at all times to market requirements and consumer wishes, because, whether fruity, salty, soft or crunchy: variety at the point of sale is increasing – and not only for the products themselves. From the family pack with a mixed assortment through the practical snack package for on the go to exclusive limited editions, consumers expect a large number of variants and options for personalisation.

Mechanical engineering meets Big Data in Cologne

The consequence: systems must be retooled more often. Efficiency, high machine availability as well as easy operation are at the fore for the development of systems. "Called for are highly flexible solutions that allow easy and quick format changes and are subsequently quickly ready to use again. Those who modernise and have no fear of new technologies remain competitive", says Guido Hentschke, Director of ISM Ingredients and **ProSweets Cologne**.

With their numerous sensors and actuators, the systems in the sweets and snacks industry have long been highly automated, but not consistently data-supported. The producing companies require solutions that prepare enormous quantities of in some cases unused data for process optimisations. These can be found on the Cologne fair grounds. As a first step in the direction of the digital transformation, the technology providers are integrating intelligent sensors into the existing

systems and configuring them so they can communicate with the Cloud. “Smart” sensors, with their integrated microprocessor, in addition to purely recording physical measured values, also carry out signal preparation tasks. They in this way allow reliable forecasts concerning the operating conditions of the systems, which in turn offers further possibilities for the improvement of overall equipment effectiveness (OEE).

Generative copilots for operation

In addition to continuous monitoring, the manufacturers of sweets and snacks can query their production and packaging systems via AI-supported assistants. The generative chatbots, which interact with a knowledge database, provide immediate answers to all operations questions. The basis of data, constantly growing through machine learning, can provide assistance in communication with the machines and contribute to the optimisation of production efficiency. The assistants can help automate routine tasks. In combination with guided format changes, companies in this way establish efficient processes, in which every step is verified. Production interruptions due to false format parts can be eliminated.

The sensors don’t always have to be installed statically and directly in the systems. Common polycarbonate moulds that pass through a chocolate system equipped with measurement technology can examine areas that are difficult to see, such as refrigerators, shaping stations and vibration. Mechanical influence parameters and temperatures can thus be monitored in real time. The sensors recognise, for example, transitions with non-parallel chains in a casting system in that the mould revolves around the vertical axis. Errors can in this way be detected early on, making it possible to initiate targeted measures before malfunctions occur.

Sensors with integrated intelligence

Smart sensors represent a perfect basis for the implementation of Artificial Intelligence for making data-based decisions.



"AI and machine learning are high-performance technologies with the potential to enduringly change the manufacture of sweets and snacks. Even today, the systems act increasingly proactively, with the goal of improving quality standards and deploying resources more efficiently", Guido Hentschke emphasises. Against this background, image-processing 2D and 3D vision sensors are currently on the march throughout the food industry. They guarantee that other products, different formats or new packaging tasks can be processed without additional effort on the same system.

The right product handling also makes a difference. Using AI-based image recognition, robots recognise different objects and reliably master the "grasp into disorder". Behind this is sophisticated vision technology combined with five or six-axis pick-and-place kinematics. Evenly arranged in the tray or flow bag, the cookies or crackers already convince with their quality and optimal presentation when the package is opened. The bandwidth of possible deployment areas for systems of this kind knows no bounds. The trade visitors of ProSweets Cologne can convince themselves of the advantages of new systems during live demonstrations at the stands.

Recognising foreign bodies in real time

In addition to high-performance pick-and-place applications, AI-supported vision sensors are in the meantime also a fixed element of quality assurance. They can classify gummi bears, bonbons or chocolates according to defined criteria as well as check portions and packages for the correct content and quantity. Progressive systems thereby rely on multispectral imaging. They recognise the chemical composition of foreign bodies in real time and identify glass and metal fragments or plastic particles in food products and packaging where this has to date not been possible. They can also sort out defective products like crumbled cookies or waffles with incorrect chocolate coatings – and that with a precision surpassing that of even the most experienced quality tester.

Deep learning-supported algorithms not only make a decisive contribution to increasing line efficiency. They can also be deployed in the context of automatic classification of raw materials, for example, for determining the quality of cacao beans. Through the provision of image material, the software can recognise defects like insect infestation or mould and determine the degree of fermentation using a colour schematic. This makes it possible to undertake targeted measures for the preservation of the characteristic chocolate flavour.

Responses to the challenges of tomorrow

Visitors can find out what role AI already plays in the optimisation of production processes today and what this means for the future from 1 to 4 February 2026 at ProSweets Cologne. The international trade fair for suppliers of the sweets and snacks industry, which takes place parallel with ISM and ISM Ingredients in Cologne, in this way also wants to provide answers to two further challenges facing the industry: the acute lack of skilled workers and increasing cost pressures.

Beyond this, the accompanying event programme addresses the major future themes of the industry and offers practical insights and impulses for manufacturers and suppliers. The focus here is on:

- **Technological innovations:** how sustainable and AI-supported solutions can make processes more efficient and future-proof.
- **Innovative ingredients and processing technologies:** new approaches that help sweets manufacturers make products healthier, more attractive and more marketable.
- **Global crises as a challenge:** from supply chain resilience to geopolitical uncertainties – strategies for allowing companies to remain resilient.
- **Sustainable packaging:** materials and concepts that combine environmental friendliness with functionality.
- **Retail experience:** how packaging at the POS becomes a brand experience and influences purchasing decisions.
- **Focus on shelf marketing:** why packaging builds a bridge between brand, marketing and people, today more than ever.

From 1 to 4 february in this way, ProSweets Cologne 2026, positions itself not only as an international industry platform, but also as a provider of impulses for answers to the most urgent questions of tomorrow.

Increased Productivity Through Efficient Handling

In the industrial automation sector, every micro-stop, can result in reduced overall productivity.
This is why buffering systems are often integrated into packaging and production lines to compensate and balance the flow of upstream and downstream machines.

One of our most effective solutions is the **Bat Buffer**, a LIFO (Last In, First Out) accumulation system designed to provide extreme flexibility.



How Does the Bat Buffer Work?

The Bat Buffer functions as a **zero-pressure accumulation system**, allowing products to be temporarily stored without compression or damage.



Key Operating Phases:

1. **Accumulation Phase**
   When a downstream machine stops or slows down, the system diverts incoming products onto a feeding conveyor. Thanks to precise inverter control, products are fed into the system at a consistent pace, ensuring they remain separated and avoid contact.
2. **Storage Phase**
   Products are stored within the buffer using a spiral structure with tight curves and straight sections. This configuration optimizes the available space, allowing maximum accumulation in a compact design.
3. **Product Release Phase**
   When the downstream machine resumes operation, the Bat Buffer reverses its flow direction and gradually returns the products to the production line. The release can be managed in two ways:
   - **Orthogonal transfer release**
     Ideal when it's necessary to maintain the original product orientation.
   - **Dynamic merger with timing belts**
     Best suited for high-speed lines, allowing the buffer to empty quickly even if upstream machines remain temporarily stopped.

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INFORMAZIONE PUBBLICITARIA

From request to complete line: how a custom confectionery system is created

"You are a company that already successfully markets confectionery products. You know the market, the customers, their needs perfectly, but you dream of making the leap towards **autonomous production**." That's exactly what happened to one of **Tecno 3** customers, and their story could be yours too.

What exactly did the customer ask us for?

"We want to produce independently, starting from the raw materials. Everything in the house." Here's what they say in the company.

Tecno 3 developed a **double-line system** which maximizes production flexibility:

A dual-function system

- **First line - Nut processing**: it transforms the shelled raw material (hazelnuts, pistachios, almonds and peanuts) into **nut paste**.
- **Second line - Neutral base creams**: a continuous refining system that creates **neutral-based creams that can be characterized** depending on production needs.

The heart of the system was the **MDC** which characterizes these creams by continuously mixing solid or liquid inclusions, allowing the **creation of infinite product variations** with a single system.

If you're considering a similar investment, here's what you should expect:

- **Custom design**: Tecno 3 technical and technological teams will develop the technology best suited to your production needs, assisting you in defining the production aspects.
- **Recipe development included**: These systems arrive already optimized for tested recipes, designed to make you competitive on the market. In the **test area** you can test and perfect your recipes before you even receive the system, while the **product safety laboratory** ensures that each formula meets all production standards.
- **Complete training**: From initial setup to day-to-day management, your team will be independent and prepared.

The results speak for themselves

Today, Tecno 3 customer's plant is operational with a production capacity of **1,000 kg/hour**, and the success is such that a doubling of the line is already being planned to reach 2,000 kg/hour.

If your company is considering investing in confectionery, you don't have to face this challenge alone. Tecno 3 technology allows the company to transform your vision into a functioning plant, with optimized recipes and ongoing support.

Why choose Tecno 3? Because they offer you a partnership that supports your success, even when it means investing additional time and resources to ensure your complete satisfaction.

Your next step in the confectionery industry starts here.

"We transform your ideas into systems that work."

(Tecno 3 - Via Mastri Cestai 2 - 12040 Corneliano d'Alba - CN - Italy - Tel. +39 0173 610564 - Fax +39 0173 619494 - e-mail: a.mattis@tecno-3.it - www.tecno-3.it)



Continuous nut paste production line (Tecno 3).

Pizza or Pinsa? With Albaequipment lines, it is possible to produce both without compromises

In today's gastronomic landscape, choices are increasingly diversified to meet the tastes and needs of a more demanding customers. Among the most beloved dishes, pizza and pinsa are timeless classics, each with its own distinctive characteristics. Pizza, with its well-established tradition, and pinsa, a more recent creation that has quickly won over many palates, offer unique culinary experiences. But how can one offer both products without sacrificing the quality of either?

The answer to this question lies in the innovative technology of **Albaequipment** lines, which enable the production of both high-quality pizza and pinsa.

Albaequipment's solutions are designed to meet the needs of those who want to produce both products with excellent results, without having to choose one over the other.

Pizza and pinsa in comparison

Pizza and pinsa, while sharing some common characteristics, require different preparation methods and processes. Traditional pizza, known worldwide, is characterized by a thin base and a thicker crust, as per the Neapolitan tradition. Pinsa, on the other hand, originates from Roman cuisine and has experienced a resurgence in recent years due to its lightness and digestibility. Its highly hydrated dough makes it more airy, soft, and with a crispy crust.

The differences in the preparation of these two specialties require the use of specific technologies for each, but often, there is no possibility of having separate production lines. Additionally, there is always the risk of having to sacrifice something in terms of quality or productivity. The question is: how can one produce both specialties without compromising on anything?



The solution to not having to choose

Albaequipment, with its experience and the quality of its equipment, has found an answer to this challenge. Its production lines are designed to meet the needs of those who wish to produce both pizza and pinsa without compromise. Thanks to cutting-edge technology and a patented system, it is possible to use a single line to produce both specialties.

One of the key factors behind Albaequipment's success is its ability to adapt the production process according to the type of dough. Albaequipment's lines are designed to handle the highly hydrated dough typical of pinsa while also ensuring the right elasticity for traditional pizza. In other words, there is no need to choose between pizza

and pinsa: with Albaequipment, both products can be made with the same efficiency and quality.

How does Albaequipment's technology work?

Albaequipment lines are designed based on a careful study of manual pizza and pinsa making. They are built on rolling systems that are easily adjusted to suit different types of preparation.

The presence of automated systems allows for perfect consistency in both pizza and pinsa, while respecting tradition and high-quality standards.

An opportunity for pizza and pinsa producers

For all industrial producers, having the ability to produce both products without having to choose is a significant advantage. Not only does it expand the offered options, but it also saves time and money by reducing the need for separate equipment for each preparation. Albaequipment, with its focus on quality and versatility, provides a unique and patented solution that delivers excellent results with a single production line.

Furthermore, the customization of Albaequipment lines allows each producer to optimize their process based on specific needs.

Albaequipment lines represent an innovative and practical solution for those who want to offer both pizza and pinsa without sacrificing quality. The ability to produce both specialties with the same equipment ensures perfect results every time.

Thanks to Albaequipment's advanced technology, it is possible to combine tradition and innovation, offering customers two exceptional products without compromise.

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Isochoric cooling process preserves dairy cream stability

Oil-in-water emulsions, such as dairy cream, can destabilise into an oily and an aqueous phase after freezing and thawing due to ice crystal formation. This US work examined the freeze-thaw stability of dairy cream after isochoric cooling at subfreezing temperatures and conventional freezing (CF).



Samples were processed under isochoric cooling conditions and under CF at -10°C, -15°C and -20°C. The stability of the emulsions was assessed by particle size distribution, visual appearance, confocal micrographs, amounts of destabilised serum, rheological properties and colour properties, as well as lipid oxidation and microbial growth after 14 days. Dairy creams conventionally frozen at these temperatures destabilised into a serum phase and a precipitate due to ice formation that caused partial and complete coalescence of the fat globules. In comparison, dairy cream samples stored under isochoric conditions showed greater stability than the control sample stored in refrigeration at 5°C, due to the absence of ice crystals and low processing temperatures. Also, no microbial growth, significant changes in flow behaviour, colour or lipid oxidation occurred for the isochoric samples.

These results, published in the **International Journal of Dairy Technology**, showed that isochoric cooling can be used to preserve dairy cream at subfreezing temperatures with no freeze-thaw destabilisation.

Isochoric freezing for improving raw milk and carrot juice safety

Isochoric freezing is a novel food preservation method that may maintain the quality and safety of products by simultaneously applying low temperatures and high pressures. An US work published in **Food Control** journal aims to determine whether isochoric freezing can improve food safety



by inactivating Shiga toxin-producing *Escherichia coli* (STEC) and *Listeria monocytogenes* in raw milk and carrot juices.

Raw milk and carrot juice samples were inoculated with cocktails of either STEC or *L. monocytogenes* and then subjected to isochoric freezing conditions in pressurized chambers set at -5, -10, and -15°C and treated for 1, 5, 7, or 10 days. Following treatment, the product was sampled for surviving pathogens. The results demonstrated that a 5-log reduction of both STEC and *L. monocytogenes* can be achieved for raw milk and carrot juice without adversely affecting quality. For STEC inoculated in raw milk, both the linear and Weibull models suggest that 10 days is required to achieve 5-log reduction at -10°C. Decreasing the temperature to -15°C led to accelerated log reduction but induced phase separation in the milk. *Listeria* in raw milk demonstrated a biphasic reduction, indicating 1.3 days is required for a 5-log reduction at -10°C. In comparison, pathogens demonstrated faster log reduction in carrot juice due to its intrinsic properties. The survival curves for STEC-inoculated carrot juice demonstrated that the 5-log reduction times were 6.9 days at -10°C and 3.8 days at -15°C. *L. monocytogenes* in carrot juice required 1.5 days at -10°C for a 5-log reduction and was eliminated (7 log cfu/ml) within 24 h at -15°C.

Isochoric freezing could be an option for milk and carrot juice processors wishing to improve food safety without applying heat. This method is not a one-size-fits-all solution, and the time and temperature will need further optimization depending on the target pathogen and intended commodity.

Optimising ohmic baking of wheat bread

Ohmic baking presents an innovative alternative to conventional baking processes. To transfer processing concepts into applications, it is crucial to understand the intricate interactions between product and process, that currently remain largely unexplored. Thus, an Austrian study delved into the ohmic baking of wheat bread and the effects of specific power input (1, 3 and 5 kW/kg) on temperature distribution, dough expansion and progression of electrical conductivity.

Various parallel plate treatment chamber configurations were employed for the ohmic



heating of 300 g of wheat bread dough. The use of 5 kW/kg significantly reduced baking times necessary to obtain a defined target temperature level and distribution (up to 84 %) compared to the use of 1 kW/kg, with a minimum heating duration of 50 s and a total energy consumption of 21 Wh. Lower specific power levels (<= 3 kW/kg) revealed benefits in terms of minimized instances of local high current density. A temperature-dependent inverse relation between the dough expansion (up to 2.8-fold) and the decrease in electrical conductivity during heating was observed. The design of the treatment chambers impacted temperature uniformity and the occurrence of over- or underprocessed product sections. According to the results, published in **Journal of Food Engineering**, chambers with thin electrodes of low height and extensive surface area exhibited benefits such as enhanced water evaporation and reduced heat loss.

Particle Size Distribution Model for Optimizing Coffee Grind

The particle size distribution (PSD) of ground coffee significantly influences its extraction, flavor, and overall beverage quality. A Thai study aimed to develop, validate, and optimize PSD models for the coffee grinding process.

Arabica coffee beans subjected to light, medium, and dark roasting were ground to 12 distinct levels ranging from fine to coarse. The PSDs were examined using laser diffraction. The Rosin-Rammler (RR) model was applied to the data by employing quasi-Newton (QN) and Levenberg-Marquardt (LM) optimization methods. Indicators of uniformity, including the uniformity index k$$ (k) $$, coefficient of uniformity (Cu), size span (Span), and coefficient of variation (CV), were computed and subsequently compared across various grinding levels and roasting types. Both the QN and LM methodologies demonstrated an excellent fit to the PSD data, evidenced by high R^2 values across all grinding levels. The medium grinding level exhibited optimal uniformity, as indicated by the high k$$ k $$ and low Cu, Span, and CV values.



Although the medium roast displayed slightly superior uniformity, the Kruskal-Wallis analysis revealed no statistically significant differences in grind consistency across the various roast types.

This study demonstrated the effectiveness of PSD modeling for characterizing coffee grind consistency. The results, published in **Journal of Food Process Engineering**, provide insights for optimizing grinding parameters to improve coffee quality, while suggesting that roast type may have a limited influence on grind uniformity compared to grinder settings. The developed models and approaches can inform coffee grinding processes and quality control.

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Food and beverage metal cans market to reach $70.72 billion by 2029

According to the **MarketsandMarkets** report, the global **food and beverage metal cans market** is projected to grow from USD 50.42 billion in 2024 to USD 70.72 billion by 2029, registering a CAGR of 7.0% during the forecast period. Metal cans remain a preferred choice for packaging food and beverages due to their ability to preserve appearance, texture, flavor, and nutritional value while ensuring food safety. However, the market faces challenges such as stringent regulations on materials like aluminum and steel and limited infrastructure in emerging regions.



Global food and beverage metal cans market dynamics

Companies are shifting to lightweight, durable food & beverage cans

In the food and beverage industry, companies are increasingly adopting lightweight and durable metal cans, leading to significant growth in the metal can market. This trend is driven by a demand for packaging solutions that provide sustainability, protection, and ease of transportation, all while minimizing environmental impact. Lightweight cans are particularly beneficial as they help reduce transportation costs and carbon emissions, which is crucial for companies striving

to meet strict environmental goals. Their durability ensures that products remain intact and protected, which is essential for maintaining quality and extending shelf life, especially for beverages and perishable foods.

Additionally, consumers are becoming more aware of sustainable packaging, prompting manufacturers to focus on metal cans, which are recyclable and maintain their structural integrity across multiple recycling cycles. Consequently, innovations in the metal can industry – such as thinner walls without compromising strength and advances in coating technologies – are enabling companies to provide superior packaging solutions that meet both regulatory standards and consumer expectations.



Move toward alternative packaging options

The metal cans market faces increasing competition from alternative packaging options like Tetrapaks, pouches, and blister packaging. These alternatives are often cheaper, more convenient, and increasingly preferred by food and beverage companies for their innovative features. Pouch and blister packaging offer several advantages, including reduced material costs compared to traditional rigid packaging and enhanced sustainability. Consequently, many fast-moving consumer goods (FMCG) companies are adopting pouch packaging to offer greater convenience to consumers.

Additionally, new designs with easy-open and easy-reclose features are being developed across various market segments. However, the rising cost of final packaging could impact sales. This dual challenge pressures companies to find a balanced approach that integrates both sustainability and cost management.

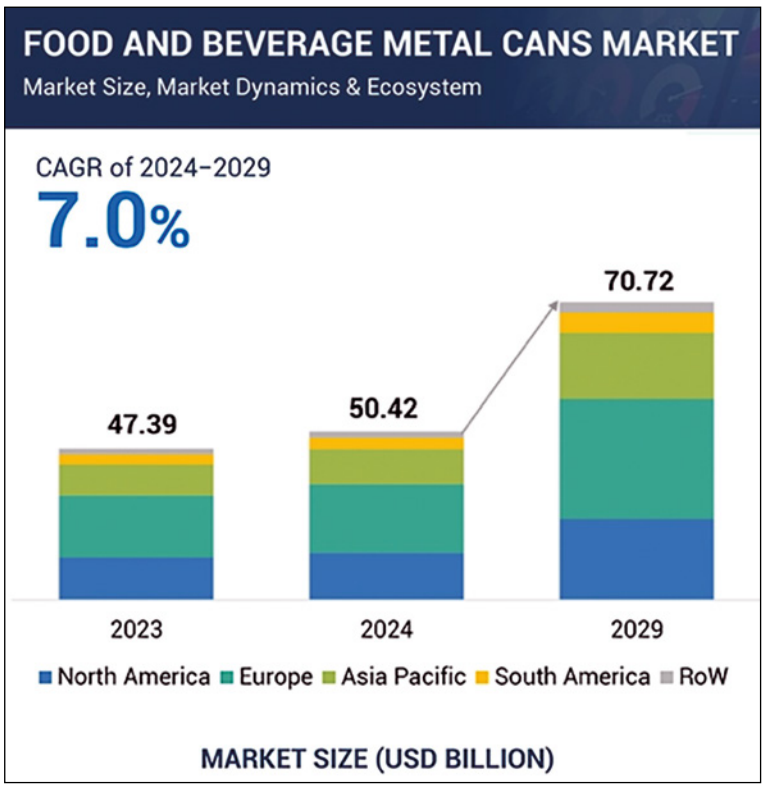
Driving Innovation in Metal Can Packaging: Sustainable Printing and Coating Solutions

With increasing consumer focus on health and sustainability, innovations in metal can packaging are meeting demands for safer, eco-friendly options. BPA-free coatings have become a key selling point, offering non-toxic solutions in response to stricter regulations. Meanwhile, advancements in printing technologies, such as digital printing and high-definition imaging, enable vibrant, customizable designs that reduce waste and enhance brand identity.

These developments not only address environmental concerns but also enhance consumer engagement, positioning the metal can industry for growth in the face of evolving regulations and market demands.

High usage of plastic packaging due to lower cost

Awareness of the benefits of metal packaging for food and beverages is limited in developing countries. Additionally, the high cost of raw materials like steel and aluminum discourages consumers from choosing canned products. A significant challenge for metal can manufacturers is the increasing use of polyethylene terephthalate (PET) bottles, particularly for beverages. Other sustainable packaging materials, such as paper, glass, and plastic, are more cost-effective than metal. Alternatives to metal cans, including Tetra Pak cartons, glass bottles, PET, and flexible pouches, as well as other innovative packaging methods, are also gaining popularity.



The growing use of these packaging options is hindering the expansion of the metal cans market. According to the British Plastics Federation (BPF) in 2020, 1.1 million tons of plastic packaging are recycled annually, with the UK recycling up to 39% of its plastic packaging each year.

Global Food and Beverage Metal Cans Market Ecosystem Analysis

The food and beverage metal cans market is driven by demand from food and beverage companies seeking durable, sustainable packaging solutions. Manufacturers produce cans using materials like aluminum and steel, focusing on recyclability and innovation to meet industry standards. Regulatory bodies ensure compliance with safety, quality, and environmental guidelines, while end users, including major beverage and food producers, adopt metal cans for their sustainability benefits. The ecosystem thrives on the growing demand for eco-friendly packaging and the collaboration between manufacturers, regulators, and end users.

The ecosystem analysis of the food and beverage metal cans industry highlights the interconnected roles of various stakeholders. Demand-side companies, including Coca-Cola, PepsiCo, and Nestlé, drive the need for packaging solutions. Manufacturers like Ball Corporation, Crown, and Ardagh Group supply the metal cans, ensuring quality and scalability. Regulatory bodies such as FSSAI, ISO, and Aluminum Association maintain safety and environmental and industry standards. End users like Heineken and AB InBev use these cans to package their beverages, aligning with sustainability and market trends. This ecosystem reflects a collaborative effort between demand, production, regulation, and consumption.

The beverage segment is estimated to account for the largest market share

Aluminum cans are widely used to package beverages like soda, beer, and wine. In contrast, metal cans are commonly employed for packaging food items such as vegetables, soups, fruits, pet food,



and meats. Beverage cans are highly valued for their portability and convenience, making them ideal for active lifestyles – hiking, camping, and other outdoor activities – due to their lightweight, durable nature that resists breakage. They are especially suitable for outdoor locations where glass bottles are prohibited, such as stadiums, concerts, and athletic events, allowing consumers to enjoy their favorite drinks anytime, anywhere.

In 2023, sustainability became a key concern for beverage brands, and this trend is set to continue in 2024. As consumers become more conscious of the environmental impact of their choices and as government regulations tighten globally, sustainability is becoming increasingly important. The European Parliament, for instance, proposed a comprehensive directive on new regulations for green claims and environmental labeling schemes. This new initiative is expected to significantly impact brands and businesses operating in the region, positively affecting the beverage industry's aluminum and steel cans use.



Based on type, 2-piece metal cans are anticipated to have the highest growth rate

Two-piece cans come in three main types: draw (shallow draw), where the height is less than the diameter; draw and redraw (DRD); and draw and iron (D&I). These cans have two parts: a body integrated with the bottom lid and a separate lid with an opening. Double seaming attaches the can body to the lids to protect the contents from external contamination. Steel and aluminum are the primary raw materials used in manufacturing these cans, making them ideal for packaging carbonated and non-carbonated beverages like beer, wine, sports drinks, and fruit juices. Two-piece cans offer several advantages over three-piece ones, such as a seamless connection between the body and bottom, allowing for a tighter seal and reduced raw material consumption.

The 2-piece cans segment in the food and beverage metal cans market has grown substantially, fueled by the rising demand for carbonated beverages like soda, energy drinks, and beer. These cans provide a lightweight, cost-effective packaging solution, making them ideal for easy transportation and handling.

The APAC market is projected to grow the fastest market

During the forecast period, the Asia Pacific region has been a key growth driver in the global metal cans market for food and beverages. Countries like China and India have significantly contributed to this growth, given their high population density and status as leading producers of fruits and vegetables. These factors are expected to increase the demand for processed food and beverages in the region, making Asia Pacific an emerging market for metal cans in the food and beverage sector. The study considers countries such as China, India, Japan, Thailand, Indonesia, Australia, and New Zealand, where market growth is anticipated to be substantial.

Various packaging types are popular in the region, including flexible, rigid plastic, paper, glass, and metal packaging. The growing population has increased demand from the food and beverage industry. In response, global players are expanding into the Asia Pacific market by establishing new manufacturing plants, further boosting the metal cans market for food and beverages.

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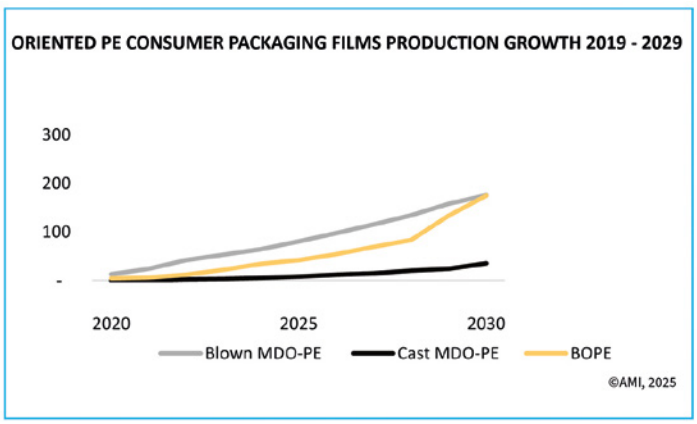
Oriented PE consumer packaging film, a confused market seeking clarity

AMI Market Intelligence has released an authoritative report offering a deep dive into the global polyethylene (PE) consumer packaging films market, providing industry stakeholders and investors with a comprehensive analysis of market dynamics, technological advancements, and competitive pressures shaping the global market.

A key highlight of the report is the growing momentum behind oriented film technologies – specifically machine-direction oriented PE (MDO-PE) and biaxially oriented PE (BOPE) – which are gaining traction in consumer packaging applications. While orientation technologies have long been established, they have only recently come to the fore in consumer packaging applications with blown MDO-PE, BOPE and newly, cast MDO-PE films available on the market. This has been enabled by collaborative efforts across the supply chain to help deliver fully recyclable, all-PE film structures.

With PE films representing the largest segment of the flexible packaging market, the recycling infrastructure is most advanced for this material. Oriented PE films are increasingly viewed as a sustainable solution, offering strong mechanical recyclability – a feature further supported by growing global investment in PE recycling capabilities.

Several leading film extruders and converters are actively championing these technologies, recognising their potential to reshape the packaging landscape. However, the path to commercialisation is capital-intensive and time-consuming. Following a wave of post-COVID investment in blown MDO-PE and BOPE capacity, the pace of expansion has moderated. Market adoption has not accelerated as rapidly as anticipated, largely due to the steep learning curve associated with new material development and the complex, multi-stakeholder nature of R&D efforts.



Demand to accelerate with legislation

Despite growing interest, the widespread adoption of oriented PE films continues to face several headwinds. Higher production costs compared to conventional films, significant capital investment requirements, and ongoing technical and performance challenges have slowed market uptake.

Initial optimism has been tempered by a disconnect between brand owners' sustainability commitments and their actual purchasing decisions, which often continue to prioritise cost over environmental benefits. Many global brands, once quick to announce ambitious sustainability targets, have since revised their goals – acknowledging that early timelines and material specifications were overly optimistic. As a result, the transition to oriented PE films is progressing more gradually, with revised targets and more flexible parameters now guiding adoption.

Looking ahead, legislative pressure is emerging as the most decisive factor driving change. Regulatory clarity is helping companies navigate the complex landscape of sustainable packaging, prompting more confident and strategic investment in recyclable film solutions. As legislation continues to evolve, it is expected to accelerate the shift toward recyclable packaging formats, including oriented PE films, and bring about more decisive industry action.

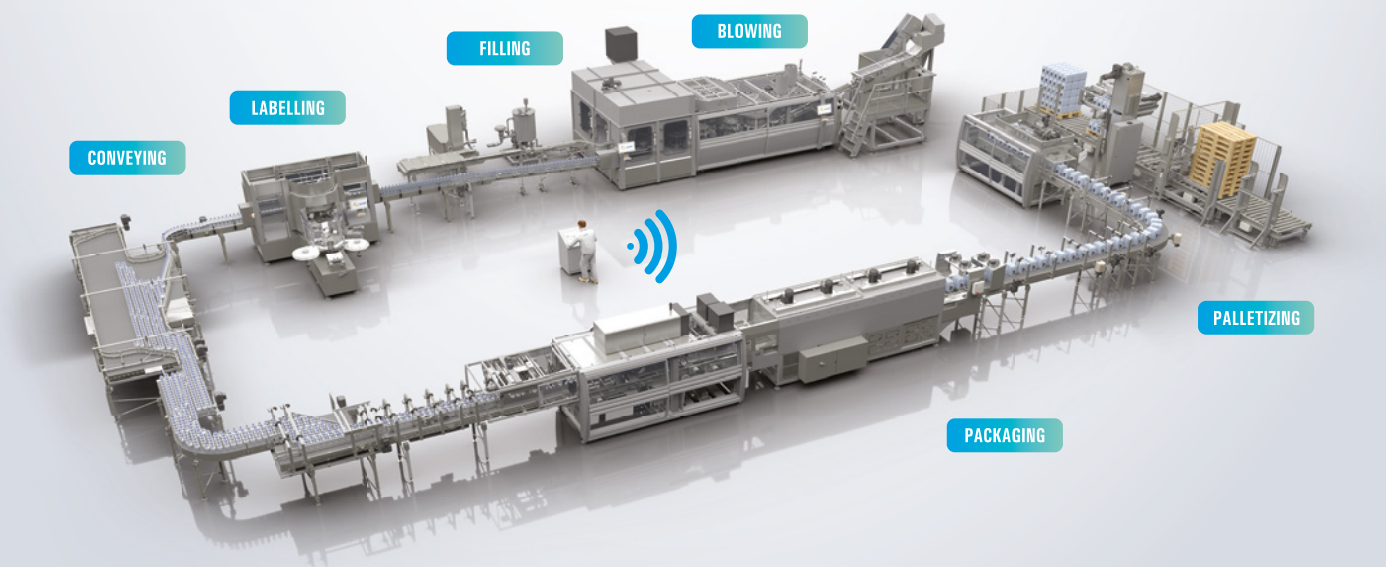
In the latest market report from AMI, titled "PE Consumer Packaging Films - The Global Market 2025", AMI's expert consultants have combined first-hand industry insight across all PE film technologies with data analysis to give a comprehensive picture of this increasingly important sector. The research, which was released in June 2025, gives investors and industry participants a thorough grasp of the competitive challenges, market dynamics, and industry development. If you are interested in hearing more about the report you can request your free proposal that contains more detail on the structure and findings included in the report by visiting the website.

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Evaluation of modified atmosphere packaging for purple passion fruit

Modified atmosphere packaging (MAP) is widely used to preserve fresh fruits. In the case of exporting products in bulk formats (2-5 kg), perforated MAP can help extend shelf life if appropriately configured to reach suitable gas levels.

A Colombian study evaluated the configuration of a perforated MAP system for purple passion (*Passiflora edulis* Sims) fruits based on modeling and simulation of changes in gas levels within the package headspace and experimental data on the respiration and transpiration of the fruits. For this evaluation, perforation-mediated multilayer bags made of polyamide and low-density polyethylene were adjusted to preserve 2 kg of purple passion fruits. The number of perforations made in the bags was predefined by performing predictive calculations to reach favorable gas levels in the packaging headspace. Subsequently, storage tests were conducted at the laboratory level (6 and 17 ±1°C) and then at the pilot level (6 ±2 and 17 ±3°C), obtaining steady molar fractions of O_2 of 0.122-0.128 and CO_2 of 0.098-0.100 and shelf life of 36 days for the fruits packaged at 6°C. Additionally, the accumulated weight loss of the fruits was monitored, obtaining values close to those previously modeled. The pre-configuration of the perforations resulted in suitable O_2 and CO_2 levels in the MAP, achieving up to 36 days of shelf life at 6°C and 24 days at 17°C. Likewise, moisture permeation through the bags resulted in low condensation with fruit weight losses of 4.8% at 6°C after 55 days in the pilot test.



This study published in **Journal of Food Science** evaluated using perforated PA/LDPE multilayer bulk bags (2 kg) to preserve purple passion fruits. The package was preconfigured (with a predefined number of perforations necessary to achieve favorable levels of O_2, CO_2, and humidity) and was compared against a commercial factory-made perforated package. By performing predictive calculations to define a suitable number of perforations, it was possible to regulate the respiration and transpiration of the packaged fruit to increase its shelf life under controlled and real conditions. This approach can be extended to any bulk-packaged fruit, and it can help select, design, and develop breathable packages that prevent decay.

Innovative active films with essential oils for meat

A South Korean study published in the **International Journal of Biological Macromolecules** aimed to investigate the effect of cinnamon essential oil (CEO) (CEO@MOF) loaded metal-organic structures on the properties of gelatin/pullulan (Gel/Pull) based composite films (Gel/Pull-based films).

The incorporation of CEO@MOF into Gel/Pull-based films demonstrated significant antimicrobial activity against *S. aureus, S. enterica, E. coli,* and *L. monocytogenes*. In addition, the integrated CEO@MOF film showed 98.16 % ABTS radical scavenging, with no significant change in the mechanical properties of the neat Gel/Pull film. The UV blocking efficiency of the composite films increased significantly from 81.38 to 99.56 % at 280 nm with the addition of 3 wt% CEO@MOF. Additionally, Gel/Pull/CEO@MOF films effectively extended the shelf life of meat preserved at 4 °C by reducing moisture loss by 3.35 %, maintaining the pH within the threshold limit (6.2), and inhibiting bacterial growth by 99.9 %.

These results propose that CEO@MOF has significant potential as an effective additive in active packaging to improve shelf life and food safety.



Controlling beef microbial spoilage with diacetyl-based active packaging sachet

Meat safety is still at the front line of consumer concern due to the need to control traditional as well as evolving pathogens, such as the ones resistant to antibiotics or preservatives, as well as other food-related stresses. For instance, bacterial pathogens such as *Escherichia coli*O157:H7 and *Salmonellaspp*. will continue affecting the safety of raw beef, which means that there is a continuous need for advanced antimicrobial solutions, such as active food packaging technologies, which are able to ensure the microbial safety of the packaged beef, while enhancing its shelf life.

The main goal of a Spanish work published in **Food Research International** journal was the development of an antimicrobial food packaging solution for fresh beef meat, able to be effective without direct contact between package and food, by incorporating food flavourings in polymeric materials. To achieve this, the antimicrobial susceptibility of L. *monocytogenes* and *S. enterica* to diacetyl was evaluated. Then, diacetyl was entrapped in active gels through a gelation reaction involving sodium stearate and ethanol. Texture profile analysis was employed to determine the optimal amount of diacetyl that effectively inhibited the growth of *Salmonella enterica* at 37°C without compromising the mechanical properties of the gel and its handling. Diacetyl release from the active gel and from an active gel blend with porous food-grade cyclodextrin nanosponges (CDNS) was quantified by gas chromatography coupled to a flame ionization detector (GC-FID) at 37°C and 4°C. At 4°C, stearate gels released 0.13 ±0.01 mg per gram of material while the CDNS blends were able to release 0.55 ±0.05 mg per gram of material. *In vivo* testing of the antimicrobial efficacy of both components (gel and blend), in the form of sachets, was conducted in a packaged fresh beef meat artificially inoculated with *Salmonella enterica* under refrigerated storage. The blend displayed superior efficacy, inhibiting *Salmonella* by 77 %, on opposite to the gel (33 %). Furthermore, both sachets exhibited a high inhibitory effect (93 to 99 %) against common bacteria found in beef meat such as total viable counts, *Pseudomonas* spp. and lactic acid bacteria.



The efficacy of these cost-effective and easy-to-produce antimicrobial GRAS sachets encourages their application as active food packaging technology, enhancing safety and extending the shelf life of fresh meat products.

Quality changes of pork ham slices packed using various methods

A Polish research published in **LWT – Food Science and Technology** journal focused on assessing the alterations in the quality of pork ham slices packaged using various methods and stored for 28 days under refrigerated conditions (0-4°C).

The meat was packed in modified atmosphere packaging (MAP): MAP80/20 (80 % O_2/20 % CO_2),



MAP70/30 (70 % O_2/30 % CO_2), MAP60/40 (60 % O_2/40 % CO_2), MAP50/50 (50 % O_2/50 % CO_2), vacuum skin packaging (VPS), and regular vacuum packaging (VP). The microbiological and physicochemical properties of pork ham were monitored throughout its long-term storage. Over the storage time, drip loss in packages increased, pH level decreased from 5.8 to 5.5 (irrespective of the packaging method). Higher O_2content in packages significantly increased lightness (L*) of meat (without influence on redness - a* color parameter) and TBARS index values. VPS and VP meat were less microbiologically stable (including the growth of psychotropic bacteria) than MAP meat. VPS meat exceeded the allowable total plate count for fresh meat (10^7 cfu/g) on day 14 and VP and MAP80/20 meat on day 28 of storage. The O_2 deficiency (VP and VPS) and its excessively high content (MAP80/20) in packages shortened shelf-life of meat.

Due to more stable gas composition, microbiological quality, and color of pork ham slices, the MAP60/40 packaging method can be recommended.

Geometry of containers and heating of foods in autoclave

US Researchers aimed to examine how different geometrically shaped trays of similar volume and construction heat when a food model system is packaged inside them.

Triangular, rectangular, oval, and round-shaped trays were filled with a food simulant and processed in a water spray retort system at a rotational speed of 6 rpm. Each retortable tray was fitted with wired thermocouples to monitor temperature variation within the trays. After filling the simulant, the trays were hermetically sealed. Trays were processed in the center of a retort rack in the vessel to prevent any movement during retort processing. Heat penetration data were collected using a total of seven thermocouples placed in each tray. A thermocouple was positioned at the geometric center of the trays, while the remaining six were placed around the tray. All thermocouple ends were located along the same center plane of each tray. Data was collected via data collection software to evaluate the heating profile of each tray. The oval-shaped (OS) tray reached internal equilibrium the fastest ($p < 0.05$) in 26 min. into processing, with the round-shaped (RS) tray following 28 min. into processing. Modeling software was then used to illustrate heat penetration data. Heat maps for the central plane of each shaped tray were generated at 2, 6, 10, 14, 18, 22, 26, and 28 min. based on physical measurements obtained from thermocouples. These maps were created to assist in understanding the heating effects influenced by tray geometry.

The study, published in **Journal of Food Process Engineering** shows that the shape of the tray significantly affects the speed and uniformity of the heating of the content. In particular, the oval and round trays show greater thermal efficiency, potentially reducing process times and improving the quality and safety of the packaged product.



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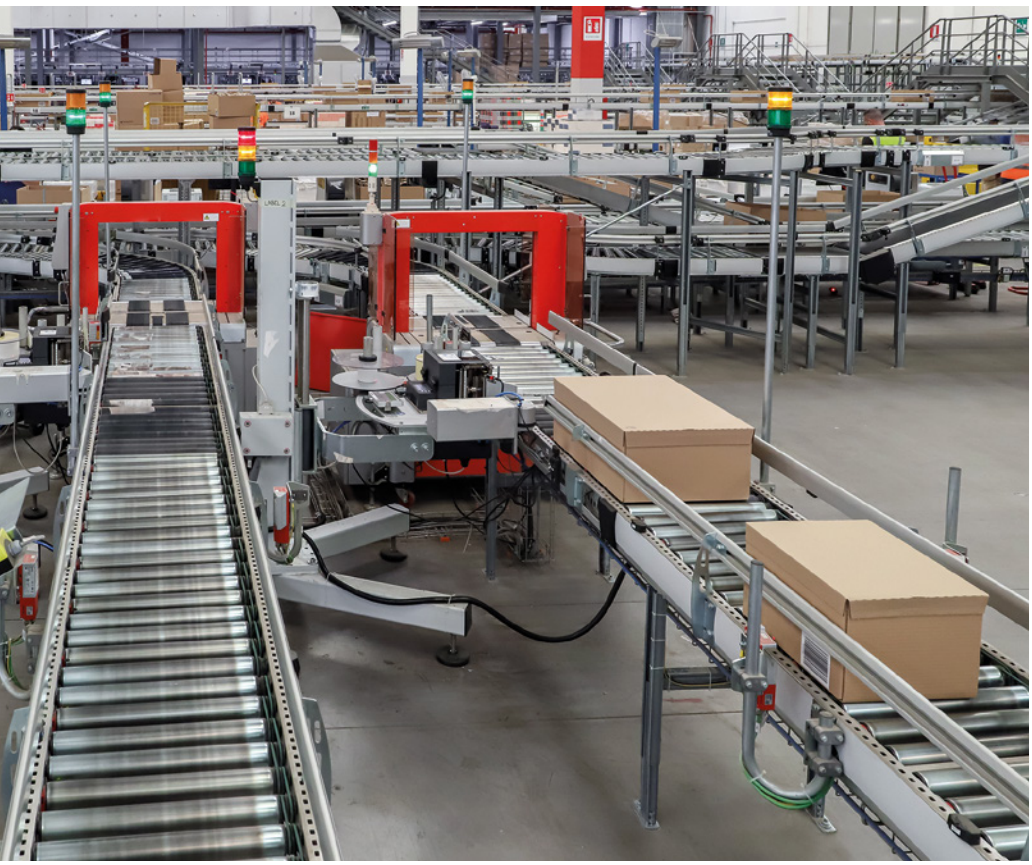
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End-of-line packaging automation to grow by $2.4 billion in five years



The global end-of-line (EoL) & warehouse packaging automation market is currently experiencing a growth phase, with a compound annual growth rate (CAGR) of 7.9% forecast between 2024 and 2029 according to **Interact Analysis**. The latest report from the market intelligence specialist – **EoL & Warehouse Packaging Automation** – predicts the market value will increase from $5.1 billion in 2024 to $7.5 billion in 2029, with the Americas region and warehouse packaging automation anticipated to be significant drivers of growth.

Companies in the Americas and Europe are increasing investment in warehouse packaging automation to combat rising labor costs. Both regions are also seeing growth in end-of-line packaging systems for the manufacturing industry as high wage bills and regulatory pressures

continue. Meanwhile, most of the growth in the APAC region stems from a general expansion of the manufacturing industry, rather than rising labor costs.

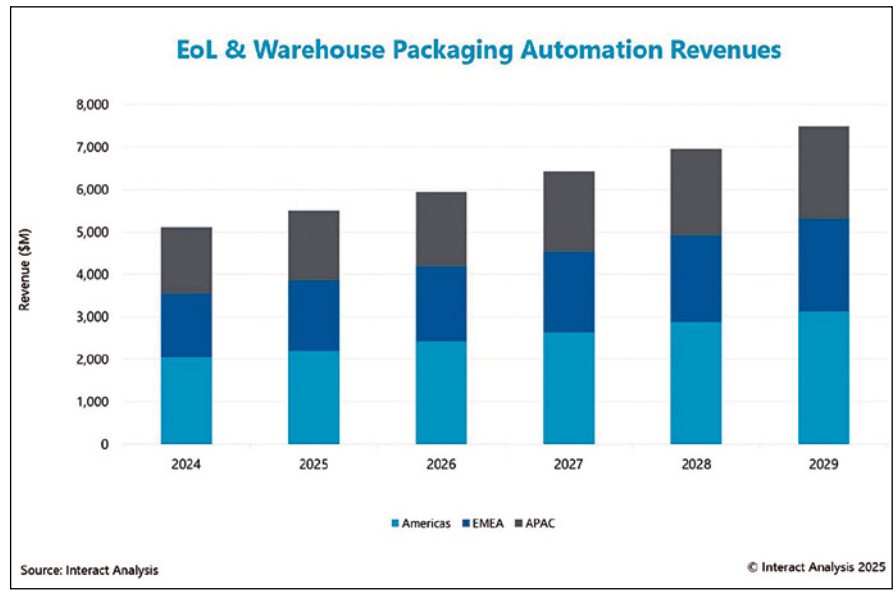
Manufacturing vs. warehousing in automated packaging

According to Interact Analysis, the end-of-line manufacturing packaging automation sector accounted for 61% of revenues within the EoL & warehouse packaging sector in 2024 and this figure is expected to drop by one percentage point by the end of 2029 to 60%, despite warehouse packaging forecast to grow at a faster rate. End-of-line manufacturing applications (like case packers, case sealers, and case erectors) have a strong presence, with combined revenues of over $2.1 billion in 2024.

The rise in warehouse automation comes primarily from rapidly growing investment in right-fit boxers, bagging machines; and robotic palletizing. E-commerce demands and legislation that penalizes retailers for material wastage are significant driving forces. Although right-fit boxers and baggers have the highest growth rate, the market size is still relatively small compared with more established solutions.

Vanessa Lopez, Research Analyst for Interact Analysis, explains: "Amazon has supercharged the expectation for automatic right-fit boxers across our forecast period. The company has announced the deployment of right-fit boxers across all its European facilities.

"Packaging automation is more mature within manufacturing environments. New machinery deployments are usually seen in newly-built facilities or where an increase in throughput is needed. However, in the warehousing sector, many packaging processes are still carried out manually, so there is greater opportunity for machine vendors here. That is why we expect higher growth in sales for warehousing applications during the forecast period."



Strong growth in automated packaging revenue is forecast in each of the tri-regions out to 2029

About the Report

End-of-Line (EoL) & Warehouse Packaging Automation is a new market report analyzing the value of packaging machines commonly used in warehouse applications.

Over the last 5 years, Interact Analysis has become the go-to market intelligence firm for warehouse automation solution providers. During this time, it has developed several datasets and tools which will be used to help size and forecast the market for packaging machinery in these applications. In addition, it has been active in providing data to packaging machine builders. The activity in both of these areas have informed its decision to produce a study examining the market for packaging machinery in end-of-line manufacturing facilities and warehouse applications.

About Interact Analysis

With over 200 years of combined experience, Interact Analysis is the market intelligence authority for global supply chain automation. Our research covers the entire automation value chain – from the technology used to automate factory production, through inventory storage and distribution channels, to the transportation of the finished goods. The world's leading companies trust us to surface robust insights and opportunities for technology-driven growth.

www.InteractAnalysis.com

Robotics and vision systems in perfect harmony

State-of-the-art production robots are, to say the least, extremely capable. The secret behind this outstanding mechanical performance lies in image processing systems that transmit essential product data to packaging robots.

Work literally rolls towards the pick & place robots: conveyor belts often transport thousands of products per minute into production and packaging lines. Which biscuit or chocolate a pick & place robot then picks up and places into a tray, for example, is decided within milliseconds – and right at the beginning of the process.

Scanners are most often located above the conveyor belts to capture key product characteristics, ranging from colour and shape to height. Depending on the operator's image recognition requirements, advanced 2D and 3D scanners are available today to meet their specific needs.



Daniel Greb is Head of Image Processing at Gerhard Schubert.



2D scanners (upper half of the image) combine several pixel-sized images into a two-dimensional surface image.

Both types have interfaces to the robot control system. They exchange the captured product data with the control system via real-time bus systems. Thanks to these, robots continuously receive coordinates at two-millisecond intervals. This allows data from up to 10,000 products to be transferred per minute – an absolute must for reliably processing large quantities in the shortest possible time.

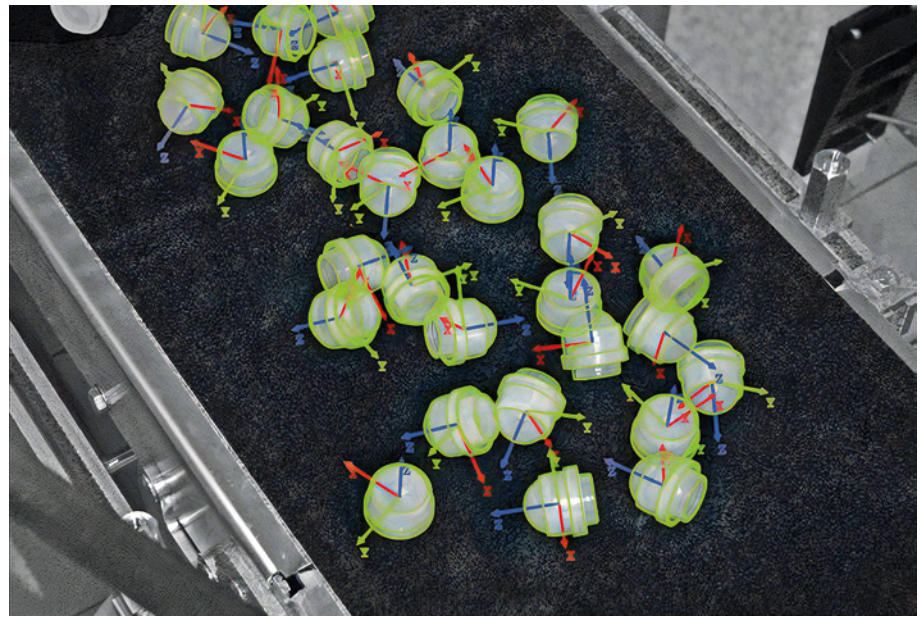
Flexible data transfer

Gerhard Schubert, which has played a leading-edge role in the development of scanner technology over the last forty years, uses its own software to transfer data to the robotics as smoothly as possible via the bus system. "We want to ensure that our image processing systems don't have to convert the data into robot coordinates before it reaches the robots – and that they remain flexible when modifications are made to the line," explains Daniel Greb, Head of Image Processing at Gerhard Schubert. For example, a manufacturer may want to integrate a robot with an additional axis into its line so that it can not only pick up products but also swivel them. In this case, the in-house software enables smooth, seamless communication between the scanner and the robot because it can be quickly reprogrammed. This enables manufacturers to flexibly change the scanners' inspection radius without having to interrupt production for long periods of time.

Intelligent tools

Different scanners need different types of information. Unlike 2D scanners, 3D variants capture the height of products, for example, which greatly facilitates quality control of multi-layered objects such as sandwich biscuits. A 2D scanner would always evaluate these in the same way, as it views objects telecentrically – i.e. from a bird's eye view – but height cannot be determined from above.

Scanners are intelligent tools that examine specific objects for predefined characteristics. The same applies to robots. The information provided by image processing enables them to select only those products on the conveyor belts that are allowed to continue their journey along the packaging line – and ultimately to the consumer.



3D scanners capture objects from different angles and calculate an image from multiple views that includes colour, shape, dimensions and height.



Schubert's tog.519 cobot picks up unsorted products from different angles.

Mastering complex tasks

Scanners also provide valuable support when handling unsorted objects: thanks to the additional height information provided by 3D scanners, robots can grasp objects at a specific height or angle – ideal when products within a pile may be lying flat, standing upright or touching each other. "Whereas the scanner checks, the robot selects. Together, both technologies provide the basis for efficient, quality-oriented packaging processes," concludes Daniel Greb.

(Gerhard Schubert GmbH - Industriegebiet Südost - Hofäckerstraße 7 - 74564 Crailsheim - Stuttgart - Tel. +49 7951400-0 - email: info@gerhard-schubert.de - www.schubert.group)



Pick & place robots pick up the selected products using the scanner information.

MEGAPOWER Silcoat: Megadyne's silicone belt that revolutionises food packaging

In food packaging, every second counts. Freshness, safety, and quality all rely on production lines that are fast, precise, and reliable.

VFFS (Vertical Form Fill Seal) machines are at the core of this industry, and their efficiency depends on the timing belts that transmit movement, control, and power.

Among these, **Megadyne's "Pull Down" synchronous belts** support filling, sealing, and packaging across multiple industries, from chemicals to food. In food production, they are essential for packaging products such as confectionery, chips, tea, coffee, biscuits, and pasta.

Megadyne belts offer numerous advantages, including uniform wear for consistent performance, long-lasting coatings that ensure constant friction and extend the belt's durability, and high abrasion resistance, which extends the belt's service life.

Additionally, the processing of holes, grooves, and profiles with reduced tolerances provides optimal performance for the production.

As Roberto Ala, Packaging Industry Segment Manager at Megadyne, explains: "The key feature of Megadyne's 'Pull Down' synchronous belts is their unmatched ability to maintain constant speed and continuous vacuum between the belts and the packaging film. This allows precise and efficient product movement, which is critical in food production lines where every machine stop causes delays and waste."

He adds: "Megadyne's wide range of engineered belts includes rubber and polyurethane models to suit the various needs of food packaging. In addition, their continuous and uniform coatings, designed for high abrasion resistance, also offer high wear resistance, ensuring a longer belt lifespan."

MEGAPOWER Silcoat: where innovation meets performance

Megadyne's true innovation lies in **MEGAPOWER Silcoat**, engineered with groundbreaking *cast technology*. Unlike traditional belts, its silicone cover is not applied in a separate production phase, but directly formed within the mould.

The result is unparalleled resistance to delamination and performance far superior to standard solutions, providing a clear advantage for anyone looking to maximise reliability and production uptime.

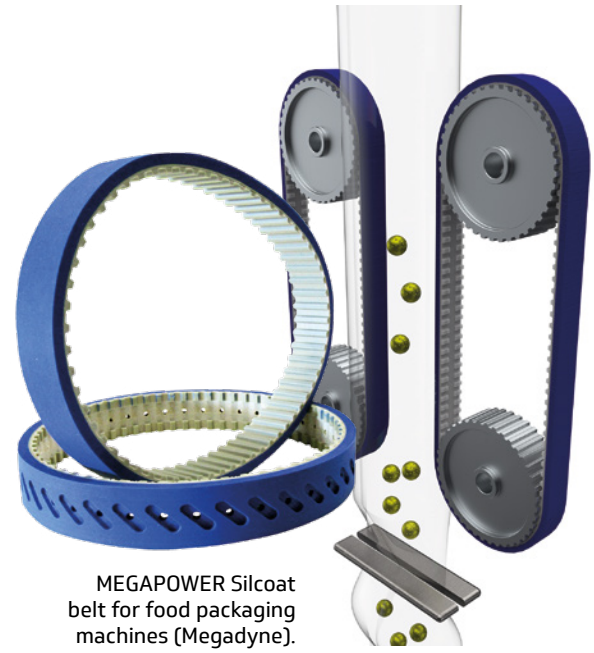
The silicone cover of MEGAPOWER Silcoat is perfectly suited for VFFS applications: it offers abrasion resistance, excellent grip on packaging film without causing damage, and consistent performance even at extreme temperatures or in humid environments. Its blue colour, certified for the food industry, adds an extra layer of safety and hygiene, making the MEGAPOWER Silcoat a reliable and high-performing choice for food producers.

MEGAPOWER Silcoat is available in two versions: a standard, non-reworked (*glossy*) version for lines that do not require extreme performance, and a high-performance (*grinded*) version, which can be customised with holes, slots, rough surfaces, and vacuum features to fit any production line.

Part of Megadyne's **MTS "Made to Stock"** range, the MEGAPOWER Silcoat is stocked for immediate delivery, reducing machine downtime and ensuring continuous production.

Megadyne's MEGAPOWER Silcoat is more than a belt: it is reliability, safety, and innovation. It is the solution that turns every packaging line into a real competitive advantage.

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MEGAPOWER Silcoat belt for food packaging machines (Megadyne).

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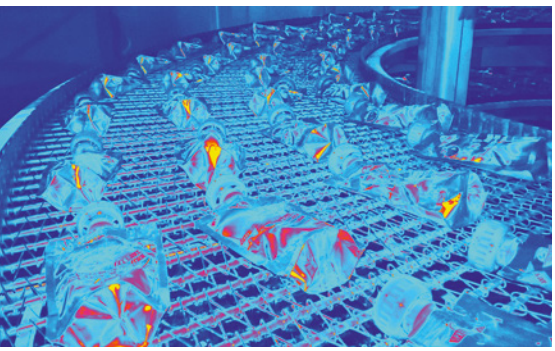
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Sarp: leading technology for pouch pasteurization and cooling

Tailor-made thermal processing lines combining pasteurization and cooling through a fully integrated system, ensuring efficiency, uniformity, and food safety.

With over forty years of experience in designing and manufacturing customized systems for the food industry, **SARP** is today recognized as a **market leader in thermal processing for filled and sealed pouches**.



Pasteurization and cooling plant for pouches (Sarp).

The company designs **complete lines that integrate pasteurization and cooling** in a fully connected system, ensuring precise temperature control, consistent product quality, and optimal energy use.

Under its dedicated business unit **Food-ID**, SARP develops advanced **thermal treatment technologies** for post-packaging processes, guaranteeing that products such as sauces, ready meals, dairy, baby food, and pet food maintain their taste, texture, and microbiological safety throughout the entire cycle.

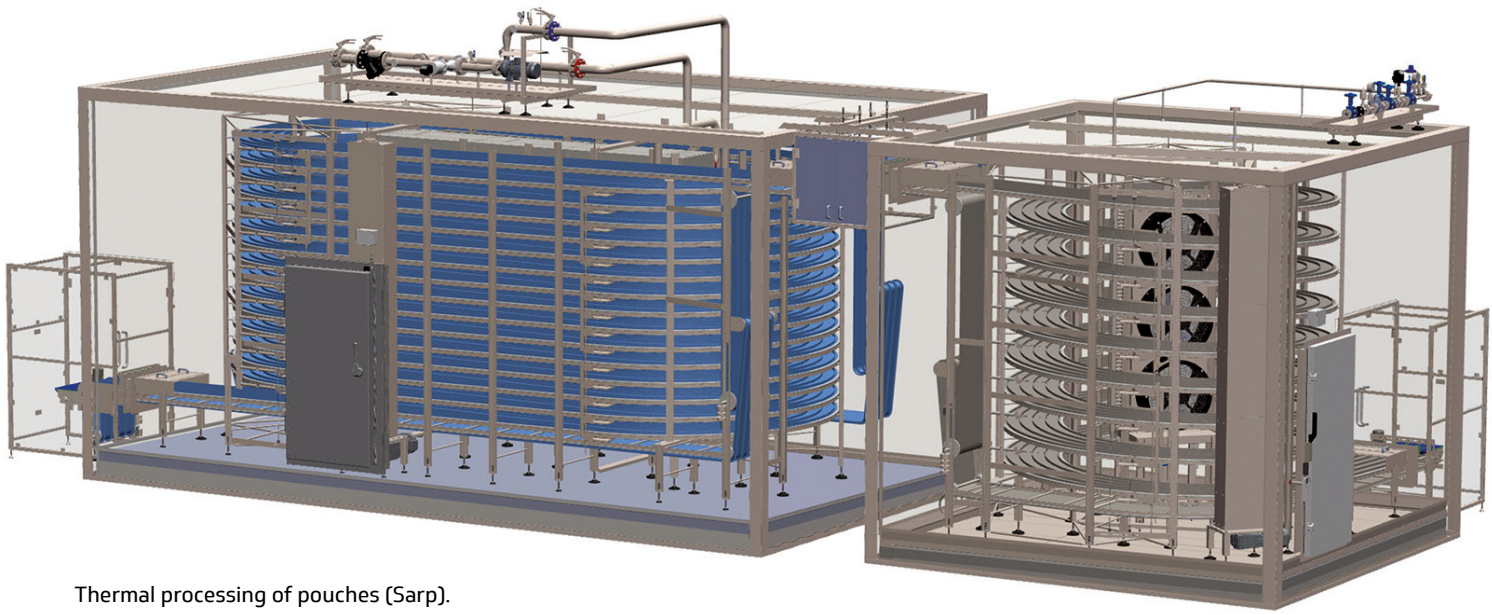
Unlike many standard solutions, SARP systems offer **independent treatment zones**, **integrated heat recovery modules**, and **modular layouts** that adapt perfectly to any production environment.

Each installation is characterized by **hygienic design**, **easy accessibility for cleaning and maintenance**, and **spiral or multi-level configurations** that deliver **high productivity within a compact footprint**.

More than equipment, SARP provides **a process-driven approach**: every project is the result of close collaboration with the customer, translating specific production needs into **efficient, reliable, and flexible thermal solutions**.

Learn more at www.sarp.it

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Thermal processing of pouches (Sarp).

Tecno Pack: Innovation, Sustainability, and Precision Engineering

Tecno Pack continues its tradition of research and development, with an ever-increasing focus on energy savings and the evolution towards completely eco-sustainable packaging.

2025 marked the debut of the flagship model among horizontal flow packers: the FP 100 HP BOX MOTION 520.

This new model has been specifically designed to ensure perfect sealing on paper, even at high speed, ensuring smooth and linear operation and eliminating all the critical issues typical of similar applications.

The FP 100 HP BOX MOTION 520 is the result of an important optimisation activity, which substantially involved both the motorisation of the reel and the longitudinal and transverse sealing units. The latter is made using an innovative box motion system with extended sealing time, capable of generating an adjustable pressure of up to 600 kg per square centimetre, ideal even at maximum operating speeds.



The FP 100 HP BOX MOTION 520 PAPER in action (Tecno Pack).

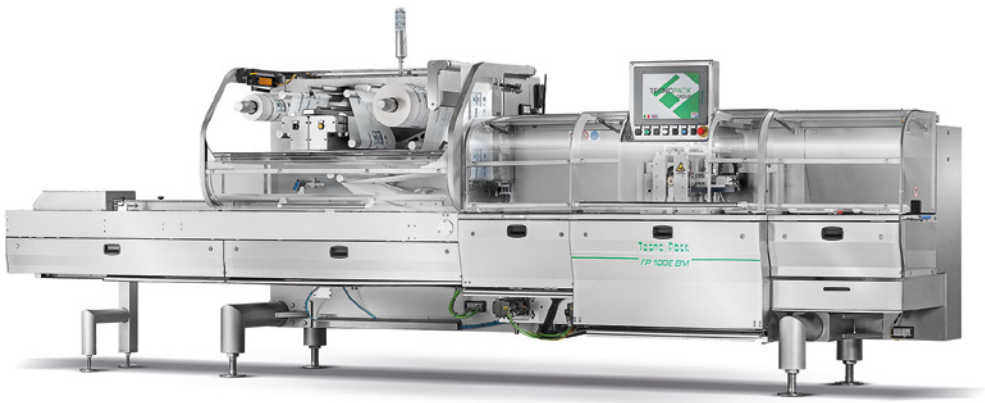
The film unwinding system is controlled by a fully automated fine adjustment system, supported by dedicated load cells, able to keep the feed of the material to the longitudinal sealing unit constant at every stage of the cycle: from start-up to maximum speed, during cyclic changes while in motion, in restarts and in automatic reel change operations.

The longitudinal sealing unit, consisting of four pairs of wheels, offers unprecedented micrometric adjustments, designed to adapt to the sealing of papers with different thicknesses and textures.

The FP 100 HP BOX MOTION 520 guarantees the production of perfectly sealed paper packages, even at high speeds (up to 160 packages per minute) with great operational fluidity: excellent performance transformed into a reliable and constant cruising speed.

Tecno Pack is therefore ready for the new challenges of industrialisation also in primary flow pack packaging, with a tested, reliable solution that is perfectly in line with the demands of the contemporary market.

(Tecno Pack - Via Lago di Albano 76 - 36015 Schio - VI- Italy - Tel. +39.0445.575661 - email - comm@tecnopackspa.it - www.tecnopackspa.it)



Horizontal flow pack packaging machines FP 100 HP BOX MOTION 520 PAPER (Tecno Pack).

Empresas Polar and SMI: investing to satisfy a growing market

The ketchup, a condiment that is increasingly fashionable and loved by young people, is experiencing steady growth in consumption. In Venezuela, the company **Empresas Polar,** for the secondary packaging of Pampero brand tomato sauce glass bottles, has recently turned to **SMI** for the installation of a **CSK 40 T ERGON packer** together with the handling systems for incoming bulk bottles and outgoing packs

Quality, practicality and flexibility

Empresas Polar is particularly attentive to the level of quality of its products, eco-sustainability and efficiency of the production systems. The CSK ERGON series proved to be the ideal solution for versatile and economical packaging of 198 g and 397 g glass ketchup bottles in practical and resistant 6x4 formats with tray+film. The machine is also prepared for the future packaging of the 567 g and 1000 g bottles in 4x3 and 3x2 formats with tray+film.

SMI solutions for Empresas Polar

Empresas Polar invested in the purchase of a new packaging machine to increase the performance of the current Pampero ketchup production line.

The CSK series shrink wrapper ensures high flexibility and automation of production processes, fundamental factors for responding promptly to market demands. In addition, the compactness of the machine ensures optimal use of existing logistics space and easy use by operators during plant operation and maintenance activities.The model supplied, for packs with tray support, is the most suitable choice for glass bottles, as it ensures greater robustness and practicality of the package both during palletizing and during handling and storage in stores.

Key features of the CSK 40 T ERGON shrinkwrapper:

- easy format changeover
- carton magazine positioned under the infeed belt
- curvilinear cardboard climb in the initial and final section, to facilitate the insertion of the cardboard pad
- smooth product infeed system for easy channeling of loose bottles on the conveyor belt
- film cutting unit with a compact design, with high-precision film cutting operations thanks to the brushless direct-drive motor
- simplified maintenance operations thanks to the ergonomic design of the machine
- Smitec ICOS motors equipped with integrated digital servo-drive (driver), able to simplify the wiring of the machine and ensure greater energy efficiency, less noise and reduced wear of the components
- the model installed at Empresas Polar mounts an optional additional 1,150mm belt, positioned at the exit of the tunnel, for rapid cooling of the packages and better aesthetic quality of the package itself.



Key features of conveyor systems

- simple and intuitive human-machine interface
- simplified maintenance
- reduced format changeover times for the transition from one production to another
- efficient accumulation system between the shrinkwrapper outlet and the palletizer inlet.



Focus on Empresas Polar

Founded in 1941, Empresas Polar holds a leadership position in Venezuela in the food sector and is one of the most important entrepreneurial structures in Latin America. Through its subsidiaries Alimentos Polar, Cervecería Polar and Pepsi-Cola Venezuela, it operates in the food, alcoholic beverages and soft drinks sectors.

(SMI - Via Carlo Ceresa, 10 - 24015 San Giovanni Bianco - BG - Italy - Tel. +39 0345 40111 - email: info@smigroup.it - www.smigroup.it)



Automation of Packaging Lines: Key Challenges and Solutions

Automating a packaging line is a strategic move for many companies, but it requires careful planning to balance production goals, financial resources, and space constraints. Drawing on nearly forty years of experience, **M.H. Material Handling** highlights that every project presents unique challenges, which can be addressed by optimizing three fundamental aspects.

Production Goals

Defining a clear production target – such as products per minute – is essential for selecting the right technologies and structuring the line for maximum efficiency. For example, in the confectionery sector, seasonal lines for chocolate can be optimized to run multiple shifts in winter and reduce capacity in summer.



Spiral conveyor to free floor space (M.H. Material Handling).

Financial Resources

Investments can be phased over time. Starting with a basic line configuration and expanding later allows companies to spread costs and reduce risks, which is ideal for businesses expecting gradual growth or increased demand.

Operating Space

Factory space is often the most critical constraint. Innovative solutions like spirals, elevators, and overhead lines help maximize vertical space and minimize floor usage. In European markets, where space is limited, these measures are often crucial for project success.

Space Management

Making the best use of available space is not just a logistical issue – it's key to increasing operational efficiency and avoiding expansion costs. Overhead lines are ideal for connecting production and palletizing areas without disrupting ground workflows. For unpackaged products, it's best to keep processing on the same level and in the same room to meet hygiene standards. Conveyors for unpackaged products on multiple levels require more complex and costly solutions than those for packaged goods. After primary packaging, elevators, spirals, and multi-level lines can connect different production stages and storage areas.



Cobot palletiser (M.H. Material Handling).

Integrating Technologies

Adding new technologies to existing packaging lines can be complex. Managing space and material flow requires careful planning to avoid bottlenecks and ensure continuous workflow. Properly connecting lines to the warehouse is essential to prevent interruptions. Adding new machines or conveyors without planning can hinder operator movement and complicate maintenance. For companies needing to keep production running during upgrades, a gradual approach – dividing the project into phases – minimizes downtime.

Looking Ahead

Investing in packaging line automation means aiming for competitive production. Optimizing space and integrating new solutions not only increases capacity but also improves safety and working conditions for operators.

(M.H. Material Handling - Via G. Di Vittorio, 3 - 20826 Misinto - MB - Italy - Tel. +39 0296720176 - email: info@mhmaterialhandling.com - www.mhmaterialhandling.com)

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Agar-based emulsion gel as a pork fat substitute in sausage

Researchers from South Korea evaluated the physicochemical properties and *in vitro* digestion behavior of the sausages when pork back fat was replaced with a canola-oil-based emulsion gel in a pork sausage model.

Three polysaccharides-agar (AG), sodium alginate (SA), and xanthan gum (XT)-were used as gelling agents, whereas isolated soy protein (ISP) and soy lecithin served as natural emulsifiers. Sausages were prepared using three treatments: conventional sausage (CS), sausage with half the pork fat replaced by an emulsion gel (RS50), and all pork fat replaced by an emulsion gel (RS100). In the meat batter incorporated with the AG-SA-XT emulsion gel, lipid droplets were uniformly dispersed into smaller sizes, resulting in reduced cooking loss ($P < 0.05$) and increased gel hardness ($P < 0.05$) in RS50 and RS100 compared with CS. Following sausage digestion *in vitro*, RS50 and RS100 demonstrated slower calcein release than CS ($P < 0.05$), whereas no significant differences in free fatty acid release were observed among the treatments ($P > 0.05$). The alpha-amino group content was higher in RS100 during the gastric phase and in both RS50 and RS100 during the intestinal phase compared to CS ($P < 0.05$). However, the content of proteins with molecular weight <3 kDa in the digesta showed no significant differences among treatments ($P > 0.05$).



According the results published in **Food Hydrocolloids** journal, adding AG-SA-XT emulsion gel as a pork fat substitute to sausages enhanced the emulsion stability and gel properties, achieved a free fatty acid release comparable to that of pork fat, and improved protein degradation.

Effects of aging and repeated freeze-thaw cycles on beef sirloins quality

An US study aimed to evaluate the influence of aging before freezing and repeated freezing on quality attributes of beef sirloins.

At 5 days postmortem, pairs of sirloins (*M. gluteus medius*) were collected from 20 beef carcasses (USDA Choice grade). The sirloin samples from each side were assigned to either no additional aging (A0) or 4 weeks of aging (A4). Samples were then subjected to either single freeze-thawing (A0FT and A4FT) or repeated freeze-thawing (A0FT x 2 and A4FT x 2) over 3 weeks. Following aging (2°C), freezing (-20°C), and thawing (2°C), the samples were evaluated for water-holding capacity (WHC), Warner-Bratzler shear force (WBSF), myofibrillar fragmentation index (MFI), color, 2-thiobarbituric acid reactive substances (TBARS), carbonyl and thiol contents, and consumer sensory evaluation (n = 120). Freezing without aging increased freeze-thaw and drip losses in A0FT and A0FT x 2 compared to A4FT and A4FT x 2 (p < 0.05). Freezing and repeated freezing decreased WBSF values (p < 0.05) regardless of aging status. Similarly, MFI was higher in A0FT and A4FT compared to A0 and A4, respectively (p < 0.05). Both freezing and repeated freezing increased TBARS levels (p < 0.05). Moreover, freezing without aging reduced CIE *L*, a*, b** and chroma values (p < 0.05). However, aged/frozen samples retained similar color attributes to never frozen counterparts (p > 0.05). Consumer sensory panel reported improved sensory attributes of aged/frozen samples, without any adverse effects from repeated freezing.



These findings published in **Applied Food Research** journal indicate that aging can improve WHC, color, and tenderness of single or repeated frozen/thawed beef sirloins, suggesting it as a practical strategy for the industry to improve meat quality and value of frozen/thawed beef.

Development of a fermented pistachio-based beverage

A study conducted by the ISA-CNR Institute of Food Sciences in Avellino (Italy) aimed to develop a fermented pistachio beverage as a plant-based alternative to milk-based drinks.

For this purpose, a colloidal mill was used to finely grind and homogenize the pistachios to obtain a homogeneous consistency and prevent sedimentation. In addition, lactic acid bacteria fermentation was used to develop unique flavours and characteristics in the final product and to achieve microbiological stability for up to 30 days of storage a 4°C.



The formulated beverages were evaluated for chemical-physical characteristics (pH, organic acid production, and fructose, sucrose, and glucose content), nutritional profile (proximate composition, amino acid and GABA content), and volatile organic composition by HS-SPME-GC/MS analysis. The pistachio-based beverages were characterized by a good source of protein, fat, fiber, and minerals (mainly K and P). The colloidal mill contributed to creating a homogeneous texture and to making the nutrients readily available to the starter microorganisms, which reached concentrations above 10^8 ufc/mL in

the final products. The beverages were characterized by pronounced acidity and some by the presence of acetoin and 2,3-butanedione, volatile components associated with a yogurt- or kefir-like aroma.

As reported in **Foods** journal, this innovative approach provides an alternative to traditional milk-based beverages and highlights the role of LAB in the development of nutritious and attractive plant-based beverages.

Physically modified plant oils as alternatives to palm fat

Palm and palm kernel oils are extensively utilised in food processing due to their unique properties, such as their semi-solid consistency at room temperature. However, growing environmental and social concerns regarding palm oil production have prompted the industry to seek sustainable alternatives to tropical or hydrogenated fats.

A Swiss project investigated the use of plant oils and their emulsified and crystallised forms as potential substitutes for palm fat in light and dark chocolate fillings, with an emphasis on single-origin ingredients to align with clean-label trends. The emulsions were assessed for viscosity, firmness, colour, and key flavour and aroma profiles. Results, published in **Foods** journal demonstrated that palm fat alternatives performed effectively in dark chocolate fillings, with non-emulsified recipes achieving firmness comparable to palm fat. In contrast, light chocolate fillings exhibited reduced firmness at higher inclusion rates of alternatives, and emulsified products were prone to flocculation. Notably, pure oil formulations delivered promising outcomes at lower inclusion rates, as the firmness could be raised by 22.0%, likely due to vegetable oil and cocoa butter interactions influencing crystal morphology. Substituting palm oil with sunflower oil, either crystallised or emulsified, did not compromise the overall flavour.

Future investigations should determine the maximum feasible level of palm fat substitution and investigate the potential of adding higher amounts of waxes and emulsifiers to enhance crystal formation and firmness.



Production of clean-label starch as a xanthan gum substitute

A Korean study explores clean-label starch as a functional alternative to xanthan gum in food applications. As reported in **Food Science and Biotechnology** journal, the optimal blending ratio of ultrasound-treated rice and potato starch was found to be 25:75, resulting in a product with enhanced stability and viscosity similar to xanthan gum. A mathematical model was developed to adjust the viscosity of clean-label starch to match xanthan gum at various concentrations and shear rates, showing high predictive accuracy (R^2 = 0.988). The clean-label starch was then tested in food applications, including as a thickener in tomato ketchup. In ketchup, samples with added clean-label starch exhibited similar serum separation and viscosity reduction as those with xanthan gum.



Overall, clean-label starch shows strong potential as a functional, clean-label alternative to xanthan gum, offering both economic and nutritional benefits in food products.

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Use of beetroot color in ice cream manufacturing

A rich source of natural color, beetroot (*Beta vulgaris* L. subsp. vulgaris) extracts and colorants offer deep red color to the dishes and boost their nutritional and antioxidant value.

A Moroccan research extracted beetroot color using Soxhlet, cold press, and ultrasonic methods. After testing the extracts



for yield %, color (L*, a*, and b*), betalains, total polyphenols, and antioxidant activity, the colorant was used to make ice cream. The results of three techniques revealed that the extract obtained from Soxhlet extraction (SE) has more total phenolic content (244.11 mg GAE/100 g), DPPH free radical scavenging activity (23.41%), significantly higher yield (48.05%), and better color results, as compared to the other extraction techniques. However, the contents of betalains (399.47 mg/L) were observed more in the extract obtained from ultrasonic extraction (UE). The extract obtained after the SE technique was further utilized in the ice cream manufacturing to check its acceptability in this product, compared to the artificial color. Six samples of ice cream were developed having different ratios of beetroot-derived color and artificial color. Control ice cream (T0) contained artificial color, whereas ice cream (T5) was developed by replacing complete artificial color with beetroot-derived color. The other treatments (T1), (T2), (T3), and (T4) contained a combination of both natural and artificial colors with different proportions. Various quality parameters of these ice cream formulations, such as pH, acidity, brix, melting rate, overrun, and specific gravity, were studied.

The result, published in **Food Science & Nutrition** journal, signified that the addition of beetroot color did not have a considerable effect on these attributes. The result of color analysis of ice cream suggested that the mean value of L* is higher in T5 (73.16), which only contains 0.1% beetroot color, and is lowest in T0 (65.24), which contains 0.1% artificial color. The addition of natural colorant resulted in a higher L* value. Sensory characteristics including color, mouth coating, flavor, aroma, texture, and overall acceptability of T5 showed more acceptance and significant results as compared to other treatments that contained artificial colors. Therefore, the beetroot-derived natural colorants could be employed to develop nutritional, healthy, and acceptable ice cream.

Maize-based snacks with white grape pomace

Grape pomace is a winery by-product with a high biological value that can be valorized in snacks production. A Romanian work aimed to explore the impact of white grape pomace type, seedless (SGPW) and with seeds (GPW) and addition level (10-40%) on the chemical, antioxidant, color, texture, and sensory acceptability of maize snacks obtained through extrusion by means of Response Surface Methodology. Furthermore, the optimal addition level for each grape pomace type was selected and the optimal samples were characterized from a molecular point of view.



The results showed that the protein, lipids, fiber, ash, total polyphenols, and antioxidant activity increased proportionally with the addition level, while the cutting force and L* decreased. The optimal samples were found to contain 29.66% SGPW or 29.22% GPW and exhibited enhanced nutritional profile and antioxidant activity compared to maize snacks used as control. The acceptability of the product was satisfactory (>7 score), which confirmed the opportunity to include these ingredients in extrusion to obtain functional snacks. The molecular characterization of the optimal samples revealed changes in absorbances intensities and the presence of additional compounds compared to the control.

These results, published in **Carpathian Journal of Food Science and Technology**, can be of real interest for producers who want to develop novel products with functional benefits and for consumers aware of a healthy diet.

Dry cacao pulp in chocolate bars: a sustainable, nutrient-rich sweetener

Cacao pulp, known for its sweet flavour, pleasant aroma, and rich nutritional content, is often discarded during cacao seeds fermentation through contaminating as so-called cacao sweatings. A study published in **Applied Food Research** journal explores the potential of cacao pulp on dry powder presentation, which in turn can offer better features as a commercial product, as a natural sweetener that could replace refined sugar, either partially or wholly, in chocolate bar formulations. For drying cacao pulp refraction windows drying (RWD) technology on a pilot scale was utilized. The drying process was studied under three operational temperatures (70°, 80°, and 90°C) and pulp thicknesses (1, 2, and 3 mm) until reaching an equilibrium moisture content of 0,12 g water/g solid across all conditions. Preservation of the nutritional and functional composition of the dried cacao pulp was assessed through measurements of phenolic compounds, vitamin C, colour, and sugar content. Equilibrium moisture was achieved within 40-60 minutes. The processed pulp exhibited high retention of phenolic compounds (79,4% to 80,5%) and vitamin C (73,5% to 75,5%), with low water activity (0,260 to 0,291). Consumer acceptance of chocolate bars formulated with natural sweetener that could totally (100% dried cacao pulp) and/or partially (50 y 75% dried cacao pulp) replace refined sugar in the formulation was evaluated via sensory analysis by 115 Colombian consumers, employing hedonic tests.



The resulting chocolate bars, especially those formulated with 50% Cacao pulp as sweetener, were well-received, indicating up to 75% sugar replacement without significant consumer resistance.

Green coffee extract as an antioxidant in mayonnaise



Mayonnaise is very susceptible to oxidation, due to the high lipid content, therefore the synthetic antioxidants are commonly used in the preparation of this sauce. The green coffee bean is one of the largest natural sources of phenolic compounds with antioxidant activity.

A Brazilian study published in **European Journal of Lipid Science and Technology** aimed to assess the feasibility of using an aqueous green coffee extract (GCE) as an antioxidant in mayonnaise. Three concentrations of GCE were tested (0.5%, 1.0%, and 1.5%). About 1.5% GCE did not affect the emulsion formation, pH, and textural parameters ($p > 0.05$). GCE demonstrated a greater delay in peroxide value during 28 days of storage when compared with synthetic agents ($p < 0.05$). GCE increased the phenolic compounds proportionally to the added concentration, enhancing their antioxidant activity compared to the synthetic agents ($p < 0.05$). About 0.5%-1.5% of GCE did not affect sensory acceptance ($p > 0.05$). GCE as an antioxidant for mayonnaise, replacing synthetic antioxidants, proved viable, especially at a concentration of 1.5%.

In light of consumers' current interest in natural and functional ingredients, the use of GCE in the production of mayonnaise represents a promising strategy for the food industry, contributing to both oxidative stability and nutritional value of the product.

Butter aroma compounds in plant-based milk alternatives

Acetoin and diacetyl are aromatic compounds that confer creamy and butter aroma to products such as yogurt and cheese. As such, they can also impart desired sensory properties to plant-based products such as dairy analogues. These compounds are produced by lactic acid bacteria, but few strains can produce amounts high enough to be considered relevant strains for its use as fermentation starters.

Therefore, in a study published in **LWT – Food Science and Technology** journal, Spanish Researchers aimed to identify a great acetoin and diacetyl bacteria producer using different reported methods. We identified the *Lactococcus cremoris* strain CNTA 939 as a great producer of these compounds and optimized its production in synthetic medium and in plant-based milk alternatives. In the latter, it was detected that the availability of free amino acids is crucial for allowing good fermentation performance by strain CNTA 939, and it was demonstrated that relevant acetoin and diacetyl titers (115 and 8 mg/L, respectively) can be achieved without adding external supplements.



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The impact of controlled fermentation temperature on properties of cacao

The content of phenolic compounds can affect the quality of cacao beans (*Theobroma cacao* L). The variation in the concentration of these compounds is influenced by factors such as cacao variety, fermentation conditions, and temperature, which play a crucial role in the method of bean drying.

In a Colombian study, the analytical method of ultra-performance liquid chromatography (UPLC-DAD-RI) was developed to identify, quantify, and examine variations in the concentrations of catechins (catechin, epicatechin, and epigallocatechin) and methylxanthines (theobromine and caffeine) by subjecting the beans to controlled temperature fermentation. Three temperature-controlled treatments were used during fermentation on three cacao genotypes (CCN 51, ICS 95, and TCS 01). The average temperature in different treatments was T1: 41.14 ±3.84°C, T2: 42.43 ±4.39°C, and T3: 43.86 ±4.74°C.

The results published in **Foods** journal demonstrate variations in the concentration of phenolic compounds across the evaluated treatments (T1, T2, and T3). Catechin levels rose from the beginning of fermentation up to day 5, after which they declined by day 6. Conversely, theobromine and caffeine concentrations decreased until day 5, then increased by day 6. A sensory analysis revealed a basic flavor profile (bitter, astringent, and acidic) that was balanced by enhancements in specific attributes, highlighting fruity, citrus, and cacao notes. A significant correlation ($p < 0.05$) was found between bitterness and the concentrations of epigallocatechin, caffeine, epicatechin, and total phenols. In contrast, a low correlation was observed between bitterness and theobromine and catechin. The astringent profile was directly correlated with epigallocatechin concentration and moderately correlated with theobromine and catechin levels. Acidic flavors showed a moderate correlation with epigallocatechin concentration. The cacao flavor was correlated with catechin and total phenols, while the citrus flavor was linked to total phenol concentration.

Notably, the decrease in phenolic compound concentrations and sensory analysis suggested that the higher fermentation temperatures observed in T3 may enhance the development of a superior flavor quality in cacao.



Preserving and re-using a whole microbial cheese community

Preserving microbial ecosystems obtained from traditional cheese-making processes is crucial to safeguarding the biodiversity of microbial cheese communities and thus ensuring that the high flavor quality of traditional cheeses is maintained. Few protocols have been proposed for the long-term storage of microbial consortia.

A French work published in **Foods** journal aimed to develop preservation methods to stabilize the entire microbial community in smear-ripened cheese without multiplication or isolation. A simplified microbial community, capable of reproducing the metabolic pattern of cheese maturation, was used in three independent cheese productions. Cheese samples were taken before and after the ripening step, mixed with maltodextrin or saline solution, and subjected to different stabilization conditions including freezing and freeze-drying, followed by 1 month of storage. Microbial survival was quantified using the colony-forming unit assay. Differential scanning calorimetry was used to relate the physical events occurring within the samples to the microbial storage stability. Freezing at -80°C resulted in the lowest loss of culturability (<0.8 log unit), followed by freezing at -20°C and freeze-drying. The ripening bacteria appeared as the most sensitive microorganisms within



the community. Moreover, a successful cheese production using the best-stabilized community showed the possibility of preserving and re-using an entire microbial community of interest.

Application of multi-frequency ultrasonic thawing on pork

An Australian study published in **Food Physics** journal, investigated the effects of ultrasonication on thawing rate, physicochemical properties, water migration, distribution and microstructure of pork at different frequency combination modes (mono-, dual- or tri-frequency sequential and simultaneous modes). The results showed that ultrasonic-assisted thawing increased the thawing rate and shortened the thawing time by 26.72-64.99% compared to water immersion thawing, and inhibited the lipid oxidation.

Regarding the quality characteristics of frozen pork, the samples thawed by combined tri-frequency sequential ultrasound mode (TSEU) at 20/50/35 kHz exhibited better water retention (lower thawing loss and cooking loss) and physicochemical quality (lowest hardness, highest tenderness, lower TBARS values). Low-



field nuclear magnetic resonance results displayed that the mobility and loss of bound and free water in pork tissue reduced effectively after ultrasound treatment at 20/50/35 kHz. The microstructure analysis revealed that the microstructure of pork thawed by 20/50/35 kHz was closest to that of fresh meat, and the distribution of muscle fibers was close and regular. Therefore, TSEU at 20/50/35 kHz was considered to be the most appropriate treatment for pork thawing, which could significantly accelerate the thawing rate and maintaining the meat quality.

Microwave-assisted extraction optimization in cocoa beans

Cocoa beans (*Theobroma cacao* L.) are an important source of polyphenols. Nevertheless, the content of these compounds is influenced by post-harvest processes. In this sense, the concentration of polyphenols can decrease by more than 50% during drying.

In this study published in **Molecules** journal the process



of procyanidins extraction was optimized and the stability of catechins, procyanidins, and theobromine to different drying temperatures was evaluated. First, the effectiveness of methanol, ethanol, acetone, and water as extract solvents was determined. A Box-Behnken design and response surface methodology were used to optimize the Microwave-Assisted Extraction (MAE) process. The ratios of methanol-water, time, and temperature of extraction were selected as independent variables, whereas the concentration of procyanidins was used as a response variable. Concerning the drying, the samples were dried using five temperatures, and a sample freeze-dried was used as a control. The quantitative analyses were carried out by HPLC-DAD-ESI-IT-MS. The optimal MAE conditions were 67°C, 56 min, and 73% methanol. Regarding the drying, the maximum contents of procyanidins were obtained at 40°C. To our knowledge, this is the first time that the stability of dimers, trimers, and tetramers of procyanidins on drying temperature was evaluated.

In conclusion, drying at 40°C presented better results than the freeze-drying method.

Production of pasta filata style cheese

A German study published in **Food and Bioprocess Technology** journal investigates the production of pasta filata style cheese from a storable, frozen intermediate material.

Homogenization (2-16 MPa, single-staged) of milk (fat/protein=0.9) was used as a tool to decrease fat globule size and consequently fat losses. Plasticization was achieved by using a single-screw extruder set up with double-jacketed hot water cycle. Non-frozen and frozen cheese curd as well as the extruded pasta filata style cheese pre-treated with different homogenization pressure was analyzed regarding the thermo-rheological properties. Fat and protein gain/loss during extrusion was evaluated by analyzing fat in dry matter (FDM) and protein in dry matter (PDM) before and after extrusion. Homogenization of cheese milk leads to a reduction of tan *delta* for thereof produced raw cheese curd material as well as the extruded products. Freezing and extrusion counteract the reduction of tan *delta*. A homogenization pressure of 8 MPa is sufficient to prevent fat losses during extrusion while still maintaining plasticization of the product for fresh and frozen material, respectively. The FDM after extrusion is 0.8% higher for fresh material and 4.9% higher for frozen material, which means that the fat concentrates during extrusion due to water loss. Moreover, there is no loss of PDM for all samples, regardless of the homogenization pressure.

A combination of homogenization pressure, freezing, and extrusion leads to a plasticizable product without losses of fat and protein. Hence, frozen cheese curd can be used as a storable intermediate.



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Recovery of milk fat from waste ice cream



The ice cream industry generates considerable waste due to stringent quality standards and food safety regulations, creating resource recovery opportunities. This US study aimed to develop an efficient method for recovering high-purity fat from ice cream wastes using ethanol-induced emulsion destabilisation.

Ice cream was treated with varying ethanol concentrations (0%-50% w/w in water) and incubated at different temperatures. Increased ethanol and temperature accelerated the separation of melted ice cream into phases (transparent liquid, continuous fat and opaque solid). Notably, 25% ethanol facilitated complete fat separation as a highly pure (>93%) phase, with the fat content exceeding 98% on a dry basis. Fat quality remained intact, as neither ethanol nor temperature affected fat hydrolysis or oxidation, based on peroxide value, free fatty acid levels and *p*-anisidine results.

The recovered fat represented about 50% of the original fat content in the ice cream, reducing waste and enhancing by-product value. These results were published in the **International Journal of Dairy Technology**.

Cryogel addition effect on ultrasound-assisted thawing of pork meat

The use of new technologies that allow for improving conventional food preservation processes is what the industry has been adopting in recent decades, with high-intensity ultrasound (US) and the application of cryoprotectant agents (cryogels) being those that have become more relevant today.



For this reason, in a Mexican study, cuts of *Longissimus thoracis* pork frozen in liquid nitrogen with and without waxy starch cryogel and thawed under controlled conditions in water immersion and with US were used, evaluating thermal parameters such as the initial zone and the melting rate of ice crystals and quality parameters such as pH, water holding capacity (WHC), microstructure, color profile, shear force, and surface changes. It was shown that the addition of cryogel modifies the initial fusion zone, that US-assisted thawing increases the fusion rate, and that both factors influence the quality parameters. However, the main effect on pH is the use of cryogel, unlike WHC, color parameters, and shear force, where the main impact is the thawing method.

These results, published in the **International Journal of Food Science**, conclude that waxy starch cryogel and the US at 50% thawing have the potential to apply assistance technology in food processing.

Ultrasound-induced gelation of proteins in plant-based milk

The growing demand for plant-based non-dairy milk alternatives has driven the development of new formulations with improved technological properties. A key challenge in this area is enhancing the versatility of plant-based products by structuring these colloidal systems to form gelled matrices. This structuring enables the production of innovative food products with diverse textures and applications.

In a Brazilian study, high-intensity ultrasound (HIUS) was investigated as a dual-purpose technology, capable of both microbial and enzymatic inactivation, particularly targeting lipoxygenase, while simultaneously promoting the structuring of gel networks in plant proteins. Almond-based non-dairy milk was selected as the model system to explore the potential of HIUS-induced gelation in achieving novel food textures. In this context, the effects of HIUS energy intensities at 6.3, 15.9, 25.5, and 36.0 W/cm^2 were investigated. HIUS processing altered the secondary and tertiary structures of almond proteins, leading to changes in solubility, molecular weight, and the formation of structured protein aggregates. This reorganization modified the rheological behavior of the almond-based milk, increasing viscosity and imparting gel-like characteristics at higher intensities. Simultaneously, HIUS partially inactivated the enzyme lipoxygenase, reduced microbial contamination to safe levels, and slightly altered the fatty acid profile. The mechanism of this phenomenon was described as alterations in alpha-helix regions of proteins, resulting in chain organization and the formation of new intermolecular interactions. Consequently, a protein gel network was structured, kinetically stabilizing the system, modifying rheological properties, particle size distribution, and entrapping phenolic compounds.



These findings, published in **Food Hydrocolloids** journal, highlight the potential application of HIUS as a tool for creating new plant-based foods with desirable textural properties.

Accelerated pork salting using needle electrode-derived pulsed electric fields

A Chinese study aimed to evaluate the effects of pulsed electric field (PEF) pretreatment on the NaCl content, protein composition, and microstructure of pork during the marination process. The results showed that needle PEF could promote salt penetration into the center of pork pieces.

Under optimal PEF conditions (3.0 kV/cm, 200 Hz, and 2400 pulses), the marination time could be reduced by almost 12 h. Protein characterization also revealed that PEF pretreatment changes myofibrillar protein properties by promoting salt penetration toward the center of pork. Furthermore, microstructural analysis demonstrated that the enhanced marination effect could be attributed to the PEF treatment-induced expansion of gaps between muscle bundles.

In this study, published in **Food Bioscience** journal, a PEF-assisted curing technique significantly ($P < 0.05$) improved salt penetration into the center of pork. Reducing the differences between internal and external salt concentrations can produce a more homogeneous marinade and reduce the marination time.



The findings suggest that PEF pretreatment is a promising and effective pretreatment technique for curing meat products.

Ohmic pasteurization of probiotic chocolate dairy desserts

A Brazilian study evaluated the effects of conventional pasteurization and ohmic heating (OH) at different electric fields (12, 16, 20, or 24 V/cm^{-1}) on probiotic chocolate dairy desserts' physicochemical, microbiological, sensory properties and volatile profiles.

Both treatments were analyzed for parameters such as pH, syneresis, cream stability index, rheology, bioactive compounds (total phenolics and antioxidant capacity), and probiotic viability (*Lactobacillus acidophilus* LA-05) over a 28-day storage period. Ohmic heating at higher electric fields (20 and 24 V/cm^{-1}) showed comparable results to pasteurization for most parameters, with non-significant differences or even higher values for some. Sensory analysis revealed that pasteurized samples were more associated with "creamy" and "firm" textures. In contrast, OH-treated samples were linked to lumps and fluidity, particularly in OH24 and OH16, respectively. Volatile compounds such as propanal and ethyl propanoate were detected across treatments, with ethyl acetate unique to OH24.

The results published in **Food Research International** journal suggest that OH, especially at higher electric fields, is a promising technology for processing probiotic dairy desserts, offering similar or enhanced qualities compared to conventional pasteurization. These findings provide insights into the potential for OH to be routinely applied in functional dairy product production.



Optimization of spray dried yogurt and its application in functional cookies

Spray-dried yogurt powder (SDYP) has shelf stability and other functional properties that improve solubility and facilitate the use, processing, packaging, and transportation of other food derivatives, such as bread and pastries on a large scale.

A Chinese research was conducted to develop SDYP and further its utilization to prepare functional cookies. Yogurt was spray-dried by employing different outlet air temperatures (OAT) (65°C, 70°C & 75°C) and inlet air temperature (IAT) (150°C, 155°C & 160°C). Spray drying shows that increasing the temperature increases nutritional loss, whereas *S. thermophilus* culture shows resistance to the intensive heat approaches. On the other hand *L. delbrueckii* subsp. Bulgaricus culture was found to be significantly affected. A total of 4 treatments, including one control for the functional cookies development.

A directly proportional relation was investigated between the increasing concentration of SDYP and baking characteristics and cookie's mineral and protein profile. Bioactive parameters like antioxidant activity of 2,2-diphenyl-1-picryl-hydrazyl-hydrate (DPPH), 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid (ABTS) and total phenolic content (TPC) were also affected significantly. The sensory profile shows an incline towards T0 (0% SDYP) to T3 (10% SDYP) in all attributes but starts to decline when the concentration of SDYP reaches 15%.

This study published in **Frontiers in Nutrition** journal suggests that by employing a certain combination of temperatures (OAT: 60°C IAT: 150°C); maximum survival of inoculated culture can be achieved, and this powder can be utilized in the development of functional cookies with enhanced sensory as well as biochemical characteristics significantly (P< 0.05).



Ultrasound-assisted extraction of chickpea proteins

Chickpea is a very good source of protein for the development of protein-enriched plant-based ingredients. Chickpea protein isolates are primarily obtained by wet extraction methods such as alkaline or salt extraction. The energy input required for the production of chickpea protein isolates can have an impact on both the environment and processing, thus affecting nutritional quality and human health. Therefore, further research is needed to develop mild processing techniques for the isolation of chickpea proteins.

In a Turkish study, with the aim of developing a more efficient and effective method, chickpea proteins were isolated by ultrasound-assisted extraction and the process parameters were optimised using the Box-Behnken design.

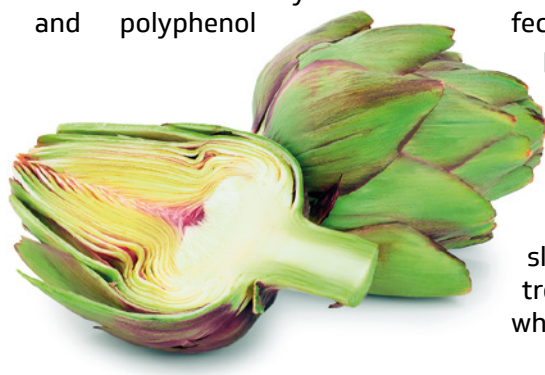
Under the optimal extraction conditions (solid/solvent ratio 13.42 g/100 mL, pH=8.8, extraction time t=10 min, ultrasound amplitude 70 %), the highest extraction yield was obtained, 66.1 % with ultrasound-assisted extraction and 55.1 % with the conventional alkaline method. When comparing the ultrasound-assisted method with the conventional alkaline method, it was found that a higher protein isolation yield was obtained with a 6-fold shorter processing time and a 29-fold lower energy consumption. Moreover, it was found that the water/oil absorption properties of the protein isolate obtained by the ultrasound-assisted method increased and its foaming properties improved.

This research, published in **Food Technology and Biotechnology** journal, presents a feasible ultrasound-assisted extraction technique for the isolation of chickpea protein, which can then be used as a versatile ingredient in the food industry.



Microwave treatments to reduce browning of fresh-cut artichokes

The objective of this work was to evaluate the effect of mild microwave (MW) treatments (spanning from 31 to 99 J g^{-1}) as an alternative to chemical dipping to prevent post-cutting browning of fresh-cut artichokes. Artichokes ('Madrigal') were treated before or after cutting and then wrapped in polyvinyl chloride (PVC) film for 6 days of storage at 5degreeC. Quality parameters were analyzed including gas composition within the package, visual quality of receptacle and cut bracts (appearance score), color parameters, total phenol content, antioxidant activity and polyphenol oxidase activity (PPO). MW treatments (applied either on whole, before trimming, or on pre-trimmed artichokes) resulted effective in delaying browning and preserving post-cutting quality of fresh-cut artichokes compared to non-treated ones. Some differences were also noticed between the MW-irradiated samples with a slight better performance when treatment was made on the whole artichoke. When coupled



with modified atmosphere packaging MW treatment still proved to be effective in delaying browning of cut surfaces.

Results, published in **Acta Horticulturae** journal, showed that application of mild MW treatments may reduce the browning potential of fresh-cut artichokes, contributing to maintain their quality attributes in order to allow a shelf-life duration suitable with the modern cold-chain distribution. Nevertheless, there are ample spaces for broader experimental approaches in order to optimize the treatment and to better clarify the thin border between the treatment effectiveness and the thermal damage on the product.

The impact of ambient temperature on arabica coffee fermentation

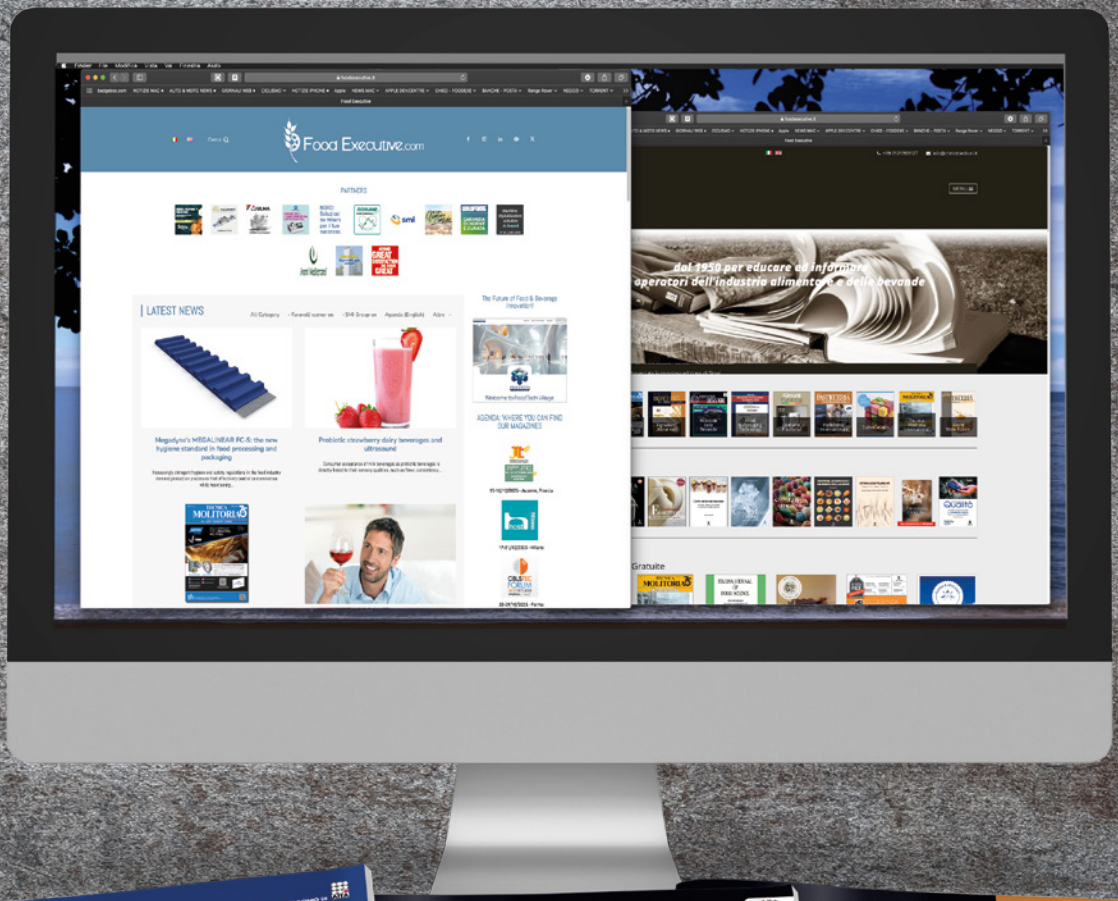
Although temperature is a key variable in fermentation processes, coffee fermentation is usually carried out without temperature control, and its effect on metabolite profiles and beverage quality are not well established. Therefore, a Brazilian study aimed to evaluate the effect of ambient temperature control during self-induced anaerobic fermentation on the physicochemical characteristics and on the quality of the coffee beverage.

Arabica coffees were fermented in solid and submerged states, with and without ambient temperature control. For the Paraiso variety, the temperature was controlled at 18°C, and for the Arara variety, the temperature was controlled at 27°C. The results indicated that temperature control facilitated increased microbial activity during fermentation, as indicated by a more substantial reduction of sugars at the earlier stages of the fermentation process. In the sensory evaluation, an average increase of 3.5 points was observed for the best scored coffees obtained at controlled temperature at 27°C. Meanwhile, under 18°C temperature control condition, the highest increase observed in score was approximately 2.5 points. Temperature control at 27°C resulted in the production of coffees with the highest scores within 48 hours of fermentation, whereas at 18°C, fermentation required 72 h to achieve the best results. Among coffees obtained under external temperature control, Arara coffees exhibited higher sensory diversity than Paraiso's. The decision trees generated using machine learning techniques revealed that, for Paraiso variety coffees, temperature control and fermentation time were the most significant variables in achieving sensory evaluation scores above 84 points. Conversely, for Arara coffees, fermentation time emerged as the most critical variable.

These findings, published in **Applied Food Research** journal, indicate that ambient temperature control, especially with solid-state fermentation, contributes to improving the sensory characteristics of coffee.



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Solids Parma returns: the reference event for the bulk materials Industry

Organized by Easyfairs Italy, the 2026 edition of **SOLIDS**, a strategic event for the process manufacturing industry and part of the European network of *bulk handling events* (Solids European Series), will take place on 11–12 February at the Fiere di Parma exhibition center.

From 2026 onward, SOLIDS Parma will adopt a biennial schedule: a strategic choice aimed at ensuring increasingly relevant and practical content for visitors and exhibitors, while avoiding overlaps and redundancies.

The next edition of SOLIDS will feature a conference and training program covering highly relevant topics for the sector, often not explored in depth at trade shows. For example, there will be a regulatory and legal focus on M.O.C.A. (Materials in Contact with Food) for gaskets and components, with insights on paper, glass, recycled plastic, metals, and new European regulations (Reg. EU 351/2025 and 2025/40).

The event will also cover the flow properties of powders and granular materials, focusing on proper characterization and classification (e.g., angle of repose, density, shear testing). Methods for determining the Flow Function and applying it, including a practical example of hopper design, will be demonstrated. Additionally, methods, tests, and data interpretation for optimizing industrial processes will be illustrated. Two round tables on textile and plastic recycling are also scheduled.

WHAT'S NEW

Among the innovations at SOLIDS 2026, the Innovation Gallery will showcase – both physically and digitally – the 10 most innovative technologies selected among exhibitors. Before the official announcement, visitors will be able to explore a wide range of solutions for the management, processing, and handling of bulk and powdered materials: pneumatic and mechanical conveying, dosing and mixing, filtration and dust removal, screening, weighing, packaging, process sensors, automation, and safety and sustainability technologies. Visitors will have the chance to vote for the best innovation directly at the fair.

A brand-new feature is the SOLIDS Parma Podcast, online from September 2025: a series of episodes dedicated to powders, granules, and bulk materials, designed for professionals in the food, chemical, plastic, pharmaceutical, cosmetic, mining, and manufacturing sectors. Each episode will cover real cases, common challenges, and cutting-edge technological solutions. Topics include, for example, nanofiber filters to reduce energy consumption and extend equipment life, and the most effective strategies for dust explosion protection. The podcast offers an opportunity to stay updated, exchange ideas, and remain connected with the technical community even beyond the fair.

SOLIDS Parma targets a qualified audience from diverse and cross-sector industries, including food (including pet food), chemical-pharmaceutical, cosmetic, nutraceutical, metallurgical, agricultural, rubber and plastics, and recycling. As usual, the expected profiles include top decision-makers: CEOs, technical directors, buyers, production managers, engineers, and technicians.

www.solids-parma.it

Healthy, organic, sustainable: the future of eating out of home is at SANA Food in Bologna

From 22 to 24 February 2026, **SANA Food** comes back to BolognaFiere with a concept that's even more focused on organic, healthy, and sustainable food for the Horeca channel and specialised retail, as well as a renewed synergy with Slow Wine Fair, the fair for good, clean, and fair wine created by Slow Food.

The simultaneous staging of these two events consolidates a trade fair format that is unique in Italy, connecting the food and wine sectors and offering an integrated platform for business, networking and training to a wide range of professionals in the commercial and collective catering, restaurant-retail and retail sectors.

The new edition of SANA Food 2026 has been organised on the basis of this valuable heritage and already has some important new features in store. OoH! Lab, for example, is a multifunctional training area for the out-of-home consumption sector, offering innovative, healthy and sustainable solutions to impress customers, thanks also to the exhibitors' products. The initiative includes tastings and professional masterclasses, sensory experiences and food and wine pairings created in collaboration with Slow Wine Fair. Workshops on the most effective mise en place and analysis of the cost-benefit ratio for sustainable menus will also be proposed.

At SANA Food, where organic, biodynamic, vegan, vegetarian, PDO, PGI, TSG and health-related products will once again take centre stage, new areas of focus will be highlighted through themed itineraries and guided presentations: from the different cultivars of extra virgin olive oil to the centuries-old tradition of balsamic vinegar, and the importance of honey and bees for environmental protection. For the first time, with the Social Food Area, SANA Food will give space to fair trade and sustainable agricultural production from social reintegration contexts and land confiscated from organised crime, aimed at promoting people and territories.

www.sana.it

INTERNATIONAL EVENTS IN ITALY

28-29 October 2025 - Parma: CibusTec Forum, food processing forum - www.cibustec.it
28-29 October 2025 - Parma: Labotec, laboratory and analysis show- www.labotec.one
5-7 November 2025 – Bologna: Refrigera, freezing and refrigeration show - www.refrigera.show
14-15 January 2026 - Bologna: Marca, private label food show - www.marca.bolognafiere.it
16-20 January 2026 - Rimini: Sigep, confectionery, pastry and ice cream show - www.sigep.it
28-31 January 2026 - Verona: Fieragricola, agricultural technologies show - www.fieragricola.it
11-12 February 2026 - Parma: Solids, powder and bulk processing show - www.solids-parma.de
15-17 February 2026 - Rimini: BBTech, beer technology show - www.bbtechexpo.com
22-24 February 2026 - Bologna: Sana Food, organic food show - www.sana.it
1-3 March 2026 - Verona: Sol2Expo, olive oil show - www.solverona.com
12-15 April 2026 - Verona: Vinitaly, Italian wine show - www.vinitaly.com
21-23 April 2026 - Rimini: Macfrut, fruit and vegetable processing show - www.macfrut.com
8-10 May 2026 - Bologna: Cosmofarma, functional and nutraceutical show - www.cosmofarma.com
11-14 May 2026 - Milano: Tuttofood, food show - www.tuttofood.it
19-21 May 2026 - Milano: Packaging Première - luxury packaging show - www.packagingpremiere.it
26-28 May 2026 - Parma: SPS Italia - automation and digital show - www.spsitalia.it
27-30 October 2026 - Parma: CibusTec, food processing show - www.cibustec.it
17-20 November 2026 - Milano: Simei, beverage and wine industry show - www.simei.it
4-7 May 2027 - Parma: Cibus, food show - www.cibus.it
29 May - 1 June 2028 - Milano: Ipack-Ima, packaging, food processing and pasta show - www.ipackima.com

Advertiser index

Alba & Teknoservice - Villafranca Pad. - www.albaequipment.it ... 51
Foodexecutive.com ... 69
Foodtechvillage.com ... 63
General System Pack - Schio - www.gsp.it ... 59
Gerhard Schubert - Crailsheim (D) - www.schubert.group ... 55
IFP Packaging - Schio - www.ifppackaging.it ... 29
M.H. Material Handling - www.mhmaterialhandling.com ... 23
Megadyne - Mathi - www.megadynegroup.com ... 39
Pigo - Vicenza - www.pigo.it ... cover 1
Pinco - Stabio (CH) - www.pinco-sa.com ... 45
Sarp - Castelfranco Veneto - www.sarp.it ... cover 3
SMI - San Giovanni Bianco - www.smigroup.it ... 35
Tecno 3 - Corneliano d'Alba - www.tecno-3.it ... cover 4
Tecno Pack - Schio - www.tecnopackspa.it ... cover 2
Wolhfarth - Sordio - www.wolhfarth.it ... 11

Company directory

Alba & Teknoservice ... 25
Gerhard Schubert ... 42
M.H. Material Handling ... 50
Megadyne ... 44
Sarp ... 46
SMI ... 48
Tecno Pack ... 47
Tecno 3 ... 24



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