Global Trends and Challenges in Artificial Meat and Alternative Protein Production

Over the past decade, the food industry witnessed a surge in the popularity of alternative proteins, driven by growing consumer awareness of environmental issues, animal welfare concerns, and health considerations. However, recent trends indicate a decline in both consumer interest and investment in alternative proteins. This article explores the challenges in producing viable replacements for traditional meat, the status of sales investments, and the global outlook for protein consumption.

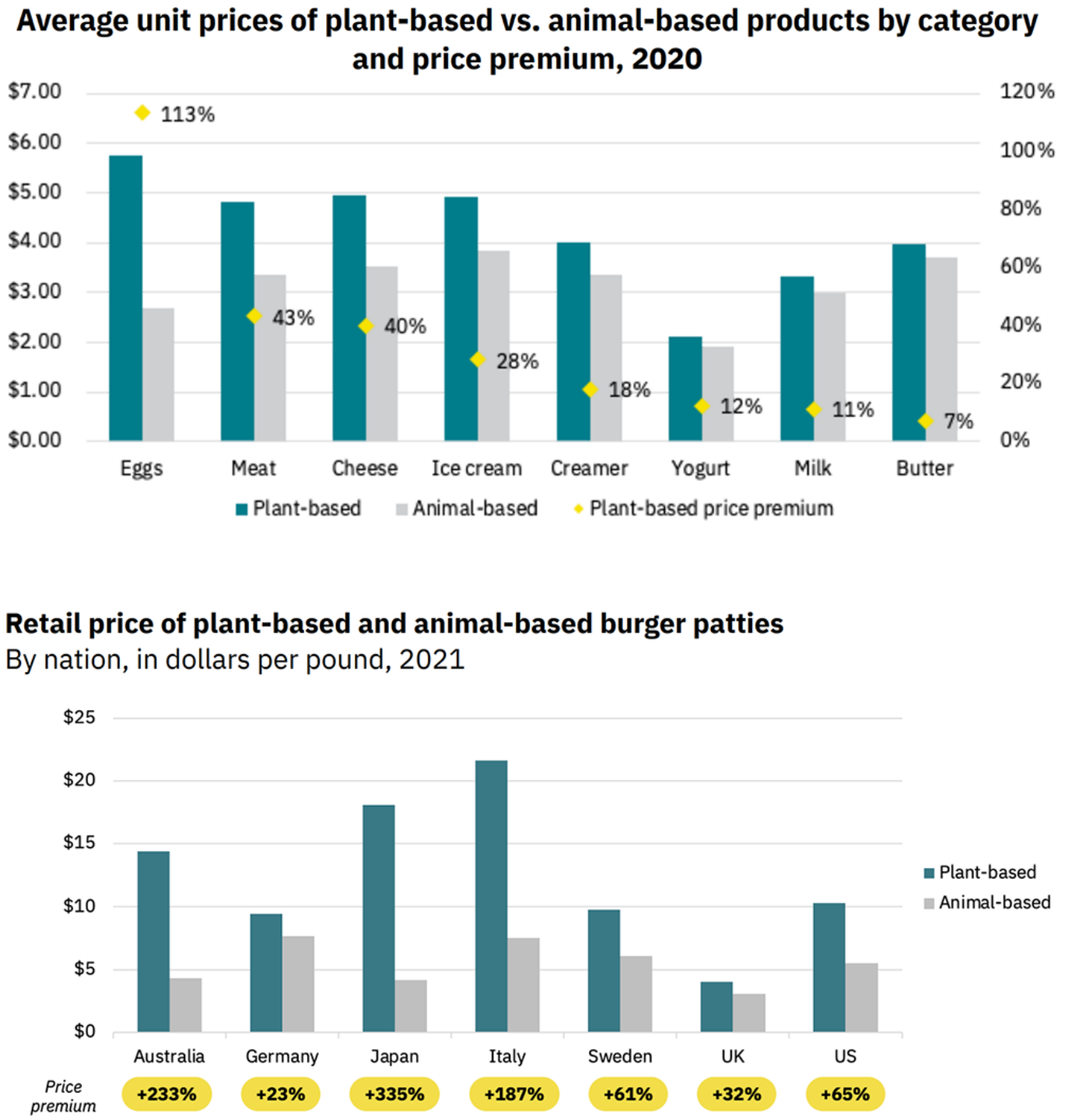

Figure 1. Uncompetitive prices of artificial meat are a critical factor in the market downturn

Challenges in artificial meat production

Producing artificial meat, also known as cultured or lab-grown meat, has been widely hyped and substantially funded over the last decade. However, many challenges remain on several levels.

Cell Culturing and Growth

Cell Source: Obtaining high-quality animal cells is crucial. Researchers typically use muscle cells (myocytes) from animals like cows, pigs, or chickens.

Cell Proliferation: Culturing cells in the lab requires precise conditions, including the right nutrients, temperature, and oxygen levels. Ensuring rapid and efficient cell growth is essential.

Scaffold Development

3D Structure: Creating a meat-like texture involves growing cells on a scaffold that mimics the natural 3D structure of muscle tissue. Developing suitable scaffolds is challenging.

Biocompatibility: The scaffold material must be biocompatible and support cell attachment, proliferation, and differentiation.

Nutrient Supply

Medium Formulation: The nutrient-rich medium used to feed the cells must provide essential amino acids, vitamins, and minerals. Designing an optimal medium is complex.

Cost Efficiency: Developing cost-effective and sustainable nutrient solutions is critical for large-scale production.

Scaling Up Production

Bioreactors: Moving from small-scale lab experiments to large-scale bioreactors is a significant challenge. Bioreactors must maintain consistent conditions for cell growth.

Energy Consumption: Scaling up production while minimizing energy consumption and environmental impact is essential.

Flavor and Texture

Taste and Aroma: Artificial meat would be expected to taste and smell like traditional meat. Achieving the right flavor profile is an ongoing challenge.

Texture: Mimicking the texture of different meat cuts (e.g., steak, ground beef) requires precise engineering.

Safety and Regulation

Food Safety: Ensuring that cultured meat is safe for consumption is critical. Contamination risks, such as bacterial growth, must be minimized.

Regulatory Approval: Cultured meat faces regulatory hurdles related to labeling, safety assessments, and consumer acceptance.

Cost Reduction

High Initial Costs: Currently, producing artificial meat is expensive due to research, development, and infrastructure costs. Reducing these costs is essential for commercial viability.

Acceptance and Perception

Consumer Perception: Convincing consumers that cultured meat is a viable and ethical alternative to traditional meat remains a challenge.

Cultural and Social Factors: Cultural preferences and traditions play a role in consumer acceptance.

Challenges in alternative protein production

As opposed to artificial meat, which still involves animal cells, alternative proteins usually designate plant-based meat imitations. However, producing alternative proteins comes with its own set of challenges.

Diverse protein sources are one challenge that is not easy to overcome. It turns out, it is quite hard to replicate the availability, as well as the diversity of health and nutritional benefits of traditional meat. While plant-based proteins have made significant progress, there's still room for improvement in terms of variety and availability.

Procuring the technology needed to extract protein efficiently and sustainably is another hurdle. Innovations in extraction methods are essential for scaling up alternative protein production.

Lower nutritional benefits of alternative proteins represent a major hurdle. Not only is it hard to mimic the entirety of meat's benefits, but plant nutritional values are notoriously fickle depending on region, soil, production type, season, and so on.

Flavor and texture remain extremely elusive. Contenders are closer to a meat-feel than before, yet this remains a major factor skewing negative in consumer perception.

Figure 2: Alternative protein producers have been unable to replicate the taste and texture of traditional meat

Scaling and Supply Chain Challenges are getting more, not less complicated. Achieving affordability at scale is essential for alternative meats to compete with traditional meat products. Additionally, ensuring a robust and efficient supply chain for alternative proteins is a concern that has not found a sustainable solution.

The Status of Alternative Protein Sales and Investment

Sales Trends

According to the Plant Based Foods Association (PBFA), overall plant-based meat units have declined by 8.2% in 2022, while dollar sales decreased by 1.2% following a significant growth phase in previous years. Similarly, Euromonitor International reported that global sales of plant-based meat substitutes grew by only 1% in 2022, a stark contrast to the double-digit growth rates seen earlier in the decade.

Beyond Meat, one of the market leaders, reported a decline in net revenues of 13.9% in the third quarter of 2022 compared to the same period in 2021. This decline reflects broader market trends where consumer enthusiasm appears to be waning.

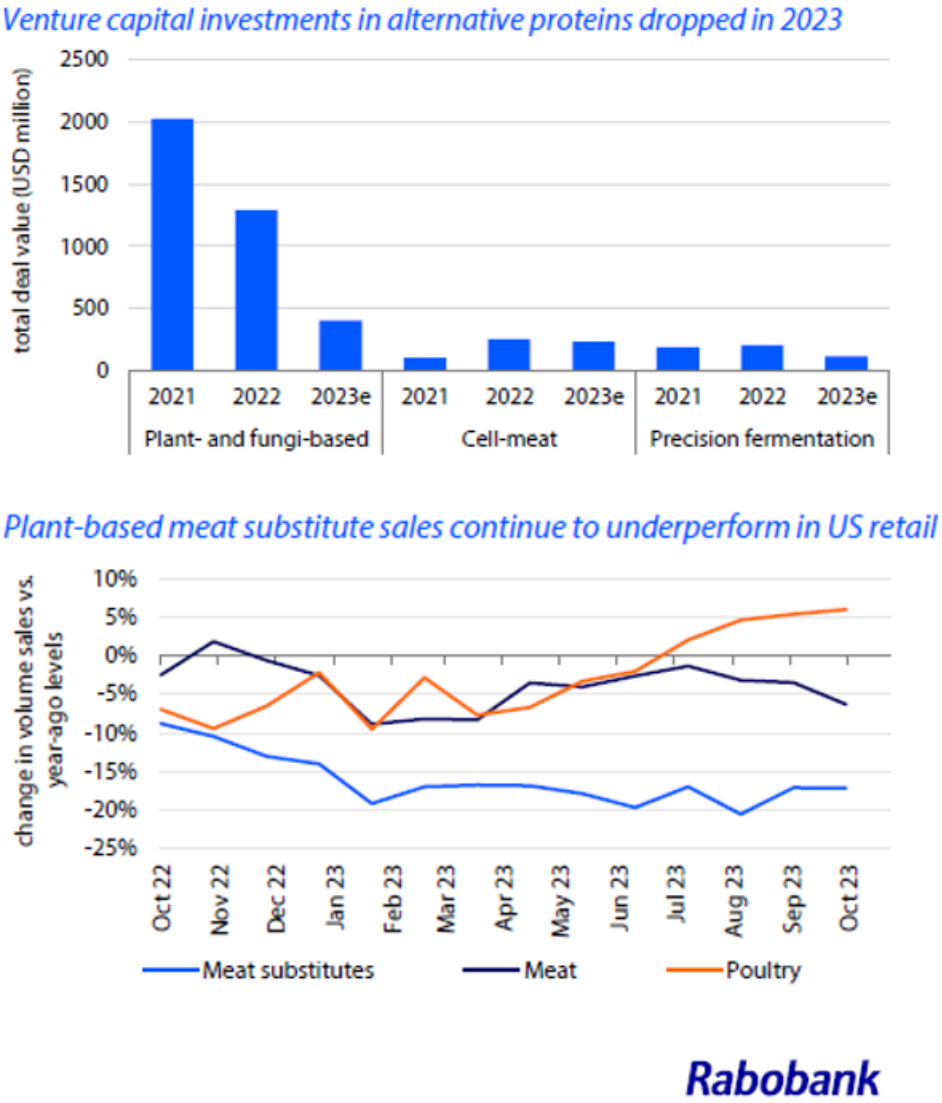

Figure 3. Rabobank indicates a downward trend in both sales and investments

Investment Trends

Investment in alternative protein startups also shows signs of slowing, with funding of sustainability food and agriculture startups dramatically declining (see Figure 2 below). According to the Good Food Institute (GFI), global investment in alternative proteins dropped 42% year-over-year to $1.2 billion in 2022, a significant decrease from the $3.1 billion invested in 2021.

The financial challenges faced by some high-profile companies have led to increased caution among investors. For instance, Beyond Meat and Oatly have both experienced substantial stock price declines, leading to a reassessment of the market's growth potential.

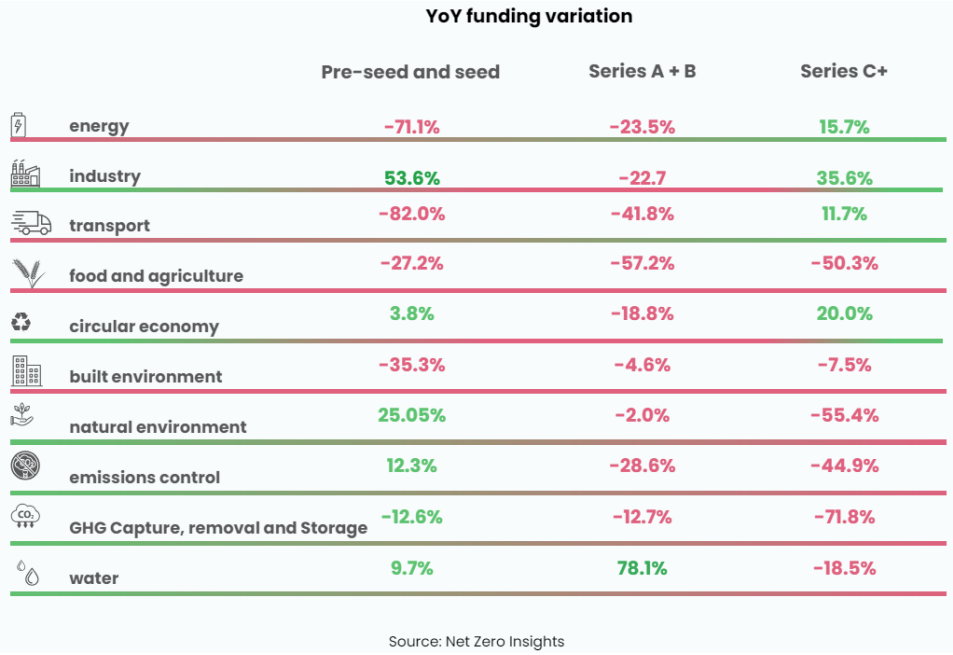

Figure 4: 2023 funding variation for climate and sustainability technologies

Factors Contributing to the Decline

Market Saturation and Competition

The initial surge in demand led to rapid market saturation. Numerous companies entered the market, resulting in intense competition and a proliferation of products. This saturation has made it difficult for individual brands to maintain market share and grow sales.

In the US, for example, plant-based milk remains the largest category, while plant-based meat and seafood sales declined substantially in 2023.

Consumer Preferences and Expectations

While early adopters of alternative proteins were driven by ethical and environmental considerations, mainstream consumers remain price-sensitive and often prefer traditional meat products (to the extent they may choose smaller meat portions over alternative proteins). Additionally, taste and texture remain critical factors. Despite advancements, many consumers still find plant-based alternatives lacking in these areas.

Figure 5: Seems fake? Consumers find it hard to believe the claims of identical taste and texture in non-meat products

Economic Factors

The global economic downturn and inflation have impacted consumer spending power. As a result, many consumers are prioritizing affordability over sustainability, leading to reduced purchases of typically more expensive plant-based products.

Regulatory and Supply Chain Challenges

Regulatory hurdles and supply chain disruptions have also played a role. The COVID-19 pandemic exacerbated supply chain issues, affecting the availability and cost of raw materials needed for alternative protein production.

Conclusion: Global Outlook for Protein and Alternative Proteins

Traditional meat consumption continues to grow, particularly in emerging markets. According to the Food and Agriculture Organization (FAO), global meat consumption is projected to increase by 14% by 2030, driven by population growth and rising incomes in developing countries.

Advances in food technology, such as precision fermentation and cell-cultured meat, offer the potential to create products that more closely mimic traditional meat. However, the recent decline in interest in alternative proteins reflects a complex interplay of market saturation, economic factors, and consumer preferences.

High prices, lack of scalability, sustainability concerns, and an inability to recreate the nutritional content, texture, and taste of meat are hurdles that cannot be easily overcome. Instead, perhaps a more accessible long-term solution might be improved sustainability in the livestock sector, accompanied by continued innovation and improvements in the production of both traditional protein and alternative proteins.