

From Grams to Global Supply Chains:

*The Hidden Scaling Reality of
Fermentation*

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 **FermBase**
by CREMER

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ABOUT FERMBASE BY CREMER

Novel fermentation is transforming how the world creates functional ingredients, proteins and fats. But scaling from lab to pilot and industrial production requires more than just a simple carbon source and salt. It requires a supply chain that keeps up with your growth. FermBase by CREMER takes over the complexity – so your teams can focus on R&D, product launches, and scaling your impact.

From pilot-scale trials to industrial production, FermBase provides the carbon sources, minerals, and premixes you need – under one roof. No more juggling multiple suppliers for each component of your media.

Backed by CREMER's global logistics network and a century of raw material expertise, we help you secure ingredients for growth markets. When you need to scale, we scale with you – reliably and predictably

To learn more visit: <https://fermbase.de/>



01 | Introduction

The global population has been expanding rapidly over the past several decades. From around 2.5 billion people in 1950, it has increased to 8.1 billion by 2024 – more than tripling in just over 70 years. Predictions suggest that the population could surpass 10 billion by 2060. The current food system is not equipped to sustain this growing population. The challenge lies in the efficiency of converting carbohydrates, which are available in large quantities, into proteins for human consumption. Today, about 77% of agricultural land is used for livestock farming, yet this produces only around 33% of the global protein supply. In contrast, the remaining 23% of agricultural land used for growing crops provides roughly 67% of the world's protein.

Climate change, supply chain instability, e.g., due to bird flu, and customer expectations for health optimization and convenience products are making protein supply increasingly challenging. Many different disciplines are working on solutions for this issue. Novel fermentation seems to be a promising technology to transform the abundant carbohydrates into high-value and nutritious proteins. Forecasts are suggesting that fermented novel proteins could make up about 4 percent of total protein production by 2050.¹ The traditional form of fermentation is a technology that dates back thousands of years when it was used as a spontaneous process on different fruits or grains. Since then, the technology has undergone significant development.

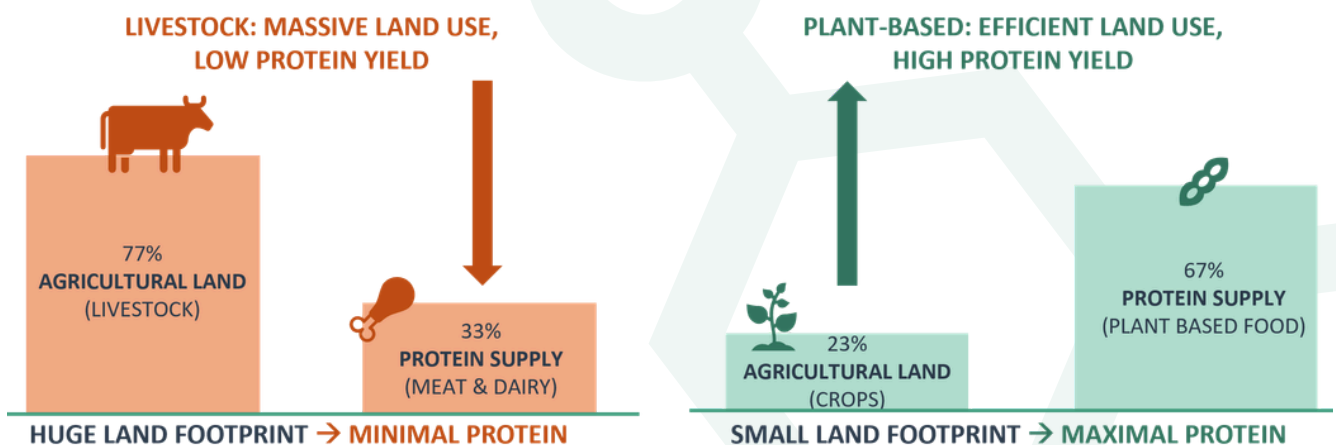


Figure 1: Adapted from OurWorldInData.org and based on UN FAO statistics

Novel fermentation, encompassing precision fermentation and biomass fermentation, has emerged as a cornerstone technology for alternative proteins, specialty ingredients, and bio-based materials.

It offers the promise of decoupling food and ingredient production from traditional agricultural constraints while reducing land use, emissions, and resource intensity.

However, scaling novel fermentation from pilot to cost-competitive, industrial-scale production remains a challenge. Across the value chain, economics are heavily shaped by feedstock availability and cost, capital intensity, energy inputs, and supply chain robustness. Among these, carbohydrate sources stand out as one of the most critical raw materials,

underpinning the operating economics and scalability of most fermentation pathways today. This industry insight examines the cost structure of feedstocks, the central role of carbohydrate sources, and the often underappreciated challenges associated with sourcing and scaling for industrial fermentation, like mineral nutrients.

02 | Cost Structure of Fermentation Feedstocks

The cost structure of novel fermentation companies differs substantially from that of conventional food producers, reflecting their hybrid nature at the intersection of biotechnology, chemical processing, and food manufacturing. While individual configurations vary by organism, product, and scale, costs generally fall into five major categories: feedstock and raw materials, capital expenditure and depreciation, energy and utilities, downstream processing, and overhead and labor.

Feedstock costs—primarily carbohydrates such as glucose—often represent 30–60% of variable expenses for large-scale fermentation, depending on yield efficiency and product value in early-stage facilities, poor yields, suboptimal strain performance,

and small batch sizes exacerbate feedstock intensity, making raw material costs a dominant economic driver. Beyond carbohydrates, additional raw materials such as nutrients (nitrogen sources, salts, micronutrients) and process aids, can also contribute significantly to costs. While smaller in absolute terms, these inputs can become challenging to source at scale and introduce further supplier dependencies.

**“Up to 60%
of variable costs are
made up by feedstocks”**

03 | Glucose as a Key Raw Material for Novel Fermentation?

Glucose is the metabolic backbone of most commercially relevant fermentation pathways. As a readily assimilable carbon source, it enables high growth rates, predictable performance, and compatibility with a wide range of microbial hosts. Consequently, glucose—typically derived from corn, or wheat—has become the dominant feedstock for novel fermentation.

From a biological perspective, glucose offers unmatched simplicity. Industrial strains have been extensively optimized around glucose catabolism, enabling higher yields and lower technical risk compared to alternative carbon sources. From an industrial perspective, glucose benefits from an established global supply chain.

However, glucose is already heavily utilized by food, beverage, pharmaceuticals, and bioethanol industries. Incremental demand

from fermentation-based proteins and ingredients risks tightening markets and increasing price volatility, particularly in regions with concentrated production. In the long term, it therefore makes sense to obtain sugar from abundant and sustainable sources. Many companies are exploring alternative carbohydrates such as sucrose, molasses, glycerol or hydrolysates from agricultural residues like lignocellulose. Compared with glucose, sucrose, molasses, and glycerol offer clear advantages for large-scale biomanufacturing in terms of cost, supply stability, and industrial readiness. Glucose, however, while readily metabolized and widely used at laboratory scale, is more highly refined and therefore typically more expensive, with pricing closely tied to food and commodity markets. In contrast, sucrose and molasses deliver equivalent fermentable sugar content at lower cost, with molasses

Glucose Feedstock Forecast for Alternative Proteins

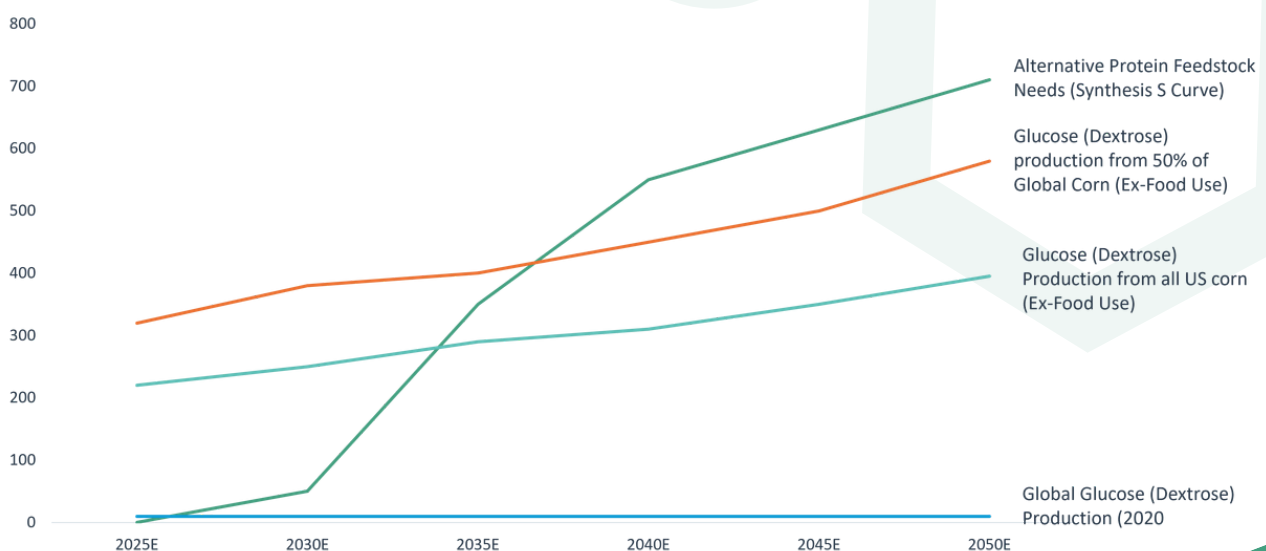


Figure 2: Glucose Feedstock forecast for alternative proteins, Adapted from USDA and Synthesis Capital Estimates (2023)

benefiting in particular from its role as a high-volume byproduct of sugar refining. Glycerol, although entering the central metabolism through different pathways than glucose, provides a highly reduced carbon source that can improve yields for selected bioproducts and is readily available from established industrial streams. As a result, these feedstocks are not only technically viable substitutes for glucose, but also align more closely with the economic and logistical realities of commercial, large-scale bioprocessing. From the biomanufacturer's perspective, there is of course still the matter of obtaining the alternative sugar inputs in the first place. Compared to the well-established global markets for from sugar derived first-generation feedstocks, the market for e.g., lignocellulosic sugars is small and fragmented. As a result, biofuel manufacturers have often resorted to establishing their own lignocellulose processing facilities in the past adding

processing complexity, capital burden, and resulting in siloed innovation. The market would profit from more specialized commercial providers that could aggregate lignocellulosic biomass and leverage economies of scale to drive down cost and improve sugar quality. Such providers could further benefit from innovations in, for example, metabolic engineering for biodegradation of sugar syrups derived from lignocellulose.²

“Carbon by-products like molasses and glycerol pair cost advantage with established industrial supply, making them compelling feedstocks for early commercial fermentation.”



04 | Mineral Salts: Hidden Constraints in Commercial Fermentation Scale-Up

Beyond carbon feedstocks, the sourcing of mineral salts represents another important consideration when developing novel fermentation processes. Although many mineral nutrients are required only in relatively small amounts, consistent quality, purity, and supply reliability are critical to maintaining process performance at scale. Established fermentation media often rely on standardized, commodity-grade salts with well-characterized specifications. Especially at large scale, the sourcing and handling of mineral salts can become a non-trivial challenge, particularly for startups transitioning from pilot to commercial fermentation volumes in the hundreds of thousands of liters. Nutrient requirements that are negligible at bench scale translate into substantial material flows at scale, often necessitating dedicated storage, dissolution, and dosing systems. For novel fermentation processes, mineral salts may also demand higher purity or customized blends, which can limit supplier options and drive up costs. In addition, companies may face import-related constraints such as regulatory requirements, tariffs, and customs procedures that complicate international sourcing. In regions where there are few or no local manufacturers capable of supplying fermentation-grade mineral salts, organizations may be forced to rely on overseas suppliers. This reliance can introduce additional challenges related to

meeting consistent quality standards across suppliers. Furthermore, long supply chains—often involving maritime transport with lead times of six to eight weeks—can reduce supply flexibility and increase inventory requirements. These logistical and regulatory constraints compound the operational challenges associated with handling mineral salts at scale. In addition to managing supply reliability, companies must also invest in appropriate infrastructure to receive, store, and process large volumes of raw materials. Such investments often include bulk handling equipment, solution preparation tanks, and automated feeding systems—capital expenditures that can be difficult for capital-constrained startups to justify early on.

Consequently, mineral salt sourcing and infrastructure must be considered not only as technical variables influencing process performance, but also as strategic supply chain considerations that affect capital expenditure, operational complexity, and scale-up risk. Approaches such as standardized, ready-to-use trace element blend solutions or centralized supply partnerships may help mitigate both infrastructure requirements and sourcing fragmentation by simplifying procurement, reducing quality variability between suppliers, and improving supply planning despite long international lead times.

05 | Single-Source Risks, Supplier Dependency, and Supply Chain Resilience

The current fermentation ecosystem is characterized by high supplier concentration and limited supply-chain resilience. Many companies rely on single suppliers for glucose, nutrients, or critical equipment. Market places, exchange platforms and other solutions to connect suppliers with buyers are necessary to keep track of the vast range. Digital supply chain visibility and closer partnerships with agricultural and ingredient suppliers can further mitigate risks.

As illustrated in Figure 3, the scaling journey from laboratory to industrial fermentation fundamentally transforms supply requirements. At lab scale, e.g. mineral salts are typically available on

demand and handled manually in gram quantities. However, as processes move toward pilot and industrial production, demand rapidly increases from grams to kilograms and eventually tons, requiring coordinated purchasing, structured supplier relationships, and dedicated infrastructure for bulk handling.

Single-source dependency increases exposure to price shocks, quality issues, and geopolitical disruptions. For early-stage companies with limited purchasing leverage, even minor disruptions can halt production. In biotechnology, start-ups are among the biggest drivers of innovation and technology,

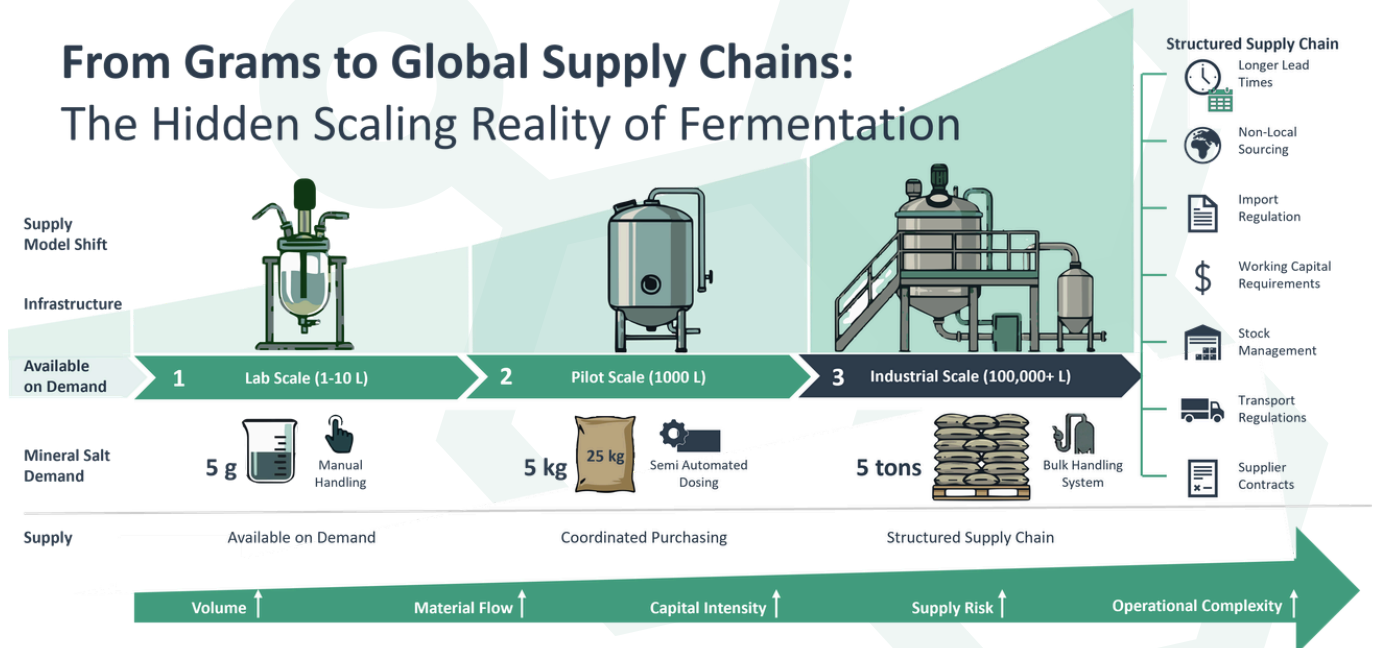


Figure 3: From Grams to Global Supply Chain, FermBase by CREMER

but minimum order quantities and small order surcharges are increasingly becoming issues for small companies. Consolidating requests from multiple companies could be helpful in this regard.

At larger scales, the supply model itself shifts significantly. Instead of relying on readily available laboratory-grade materials, companies must establish structured supply chains that account for longer lead times, non-local sourcing, import regulations, working capital requirements, and inventory management—factors that become particularly relevant once materials must be transported globally and stored in bulk quantities. This transition also increases operational complexity: material flows grow, capital intensity rises due to the need for dosing systems and bulk handling equipment, and

supply risks expand as procurement becomes dependent on international logistics and supplier contracts. As shown in the figure, these dynamics evolve progressively along the scale-up pathway, making supply chain planning a core component of industrial fermentation readiness. In combination with strong demand forecasts and partnerships, the uncertainty for suppliers and farmers could be reduced and thus improve supply reliability, enable more efficient production planning, and potentially lower costs across the value chain. As fermentation moves from niche to mainstream, supply chain strategy will become as important as strain engineering or bioprocess optimization. Companies that proactively address feedstock and supplier risks are likely to scale faster and more sustainably than those that treat supply chains as an afterthought.

06 | Conclusion

The future of novel fermentation will not be determined by biology alone. It will be determined by feedstocks. Across the industry, raw materials remain the single largest cost driver in fermentation, often accounting for up to 60% of variable production costs. As a result, feedstock availability, price stability, and sourcing resilience will increasingly define which fermentation pathways can scale economically. Glucose currently serves as the metabolic backbone of most fermentation processes, offering reliability and technical simplicity. However, its strong linkage to global food and commodity markets highlights a structural challenge: the most biologically convenient feedstock is not always the most scalable one. Over time, lower-cost and more abundant carbon sources such as molasses and glycerol are likely to play a larger role in industrial fermentation. Addressing these structural challenges will require a more coordinated ecosystem. Greater market transparency,

digital exchange platforms, intermediary service providers, aggregated purchasing demand, and improved demand forecasting could significantly strengthen supply resilience across the industry. Companies that treat feedstock strategy and supply chain design as core components of their scale-up roadmap—rather than downstream operational concerns—will be best positioned to bring fermentation technologies from pilot scale to global impact. Yet the main bottleneck is no longer biology—it is infrastructure. Markets for many alternative feedstocks remain fragmented, supplier networks are still developing, and procurement structures often lack transparency and efficiency. At the same time, fermentation scale-up transforms supply requirements: materials that appear trivial at laboratory scale quickly translate into complex global supply chains involving bulk logistics, long lead times, and supplier coordination. In other words, scaling fermentation means scaling supply chains.

Supply Chain Optimization

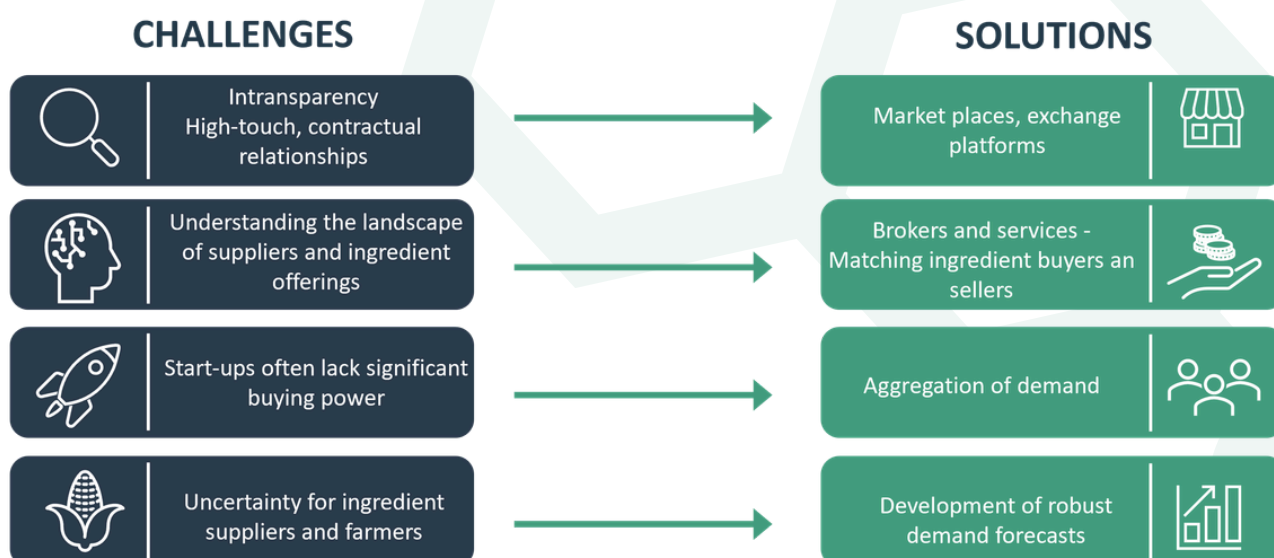


Figure 4: Supply Chain Optimization for Novel Fermentation, FermBase by CREMER

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Literature

¹McKinsey & Company; Daniel Aminetzah et al. (2025): "Ingredients for the future: Bringing the biotech revolution to food"

²Ujor VC and Okonkwo CC (2022) "Microbial detoxification of lignocellulosic biomass hydrolysates: Biochemical and molecular aspects, challenges, exploits and future perspectives."