



Fermenting the Future:

The Growing Opportunity for Products
Made with Precision Fermentation

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About This White Paper



In order to stay at the forefront of the innovative and quickly evolving landscape of tech-forward food production, The Hartman Group conducted research, sponsored by Perfect Day and Cargill, into perceptions, attitudes, and drivers related to science and technology in food, with a specific focus on precision fermentation. This white paper highlights key themes and insights from this research with the aim of introducing readers to the opportunities and paths forward for food and beverages made with ingredients from precision fermentation.

Methodology

This white paper draws on combined primary qualitative and quantitative research conducted in September and November 2022.

QUALITATIVE

September 2022

- n=19 consumers were engaged in a three-day online bulletin board exploring attitudes around FoodTech and responses to precision fermentation definitions
- n=15 consumers selected from initial sample for focus groups exploring specific precision fermentation definitions and concepts
- Key primary criteria included primary household grocery shoppers, \$70K+ HHI, mix of category usage (including plant-based alternatives), and mix of gender, race/ethnicity, and household structure

QUANTITATIVE

November 2022

- Online quantitative survey with a nationally representative sample of n=2,519 US adults 18-73 weighted to current US census on age, gender, division, income, race/ethnicity, and presence of children
- 4 monadic cells for message testing weighted to equal one another on gender and age

Now is the time for the food industry to build a strong foundation for innovative approaches to food production



WE ARE ON THE CUSP OF A REVOLUTION IN FOOD PRODUCTION. The future of the American plate — and the place of tech-forward food production methods on it — will be determined by how consumers understand the role of science and technology in food.

The past several years have seen a rapid acceleration of innovation in FoodTech. Nearly a decade after the world's first lab-grown burger debuted on TV in 2013, the first tech-forward products have begun appearing on the market. From Singapore's approval of the sale of cultivated chicken in 2020 to the FDA's recent nod to the safety of cultivated meat, new and imminent breakthroughs and product launches are increasingly putting novel methods of food production in the spotlight.

For the last three decades, the dominant story of the consumer food industry has been the growth of the natural food market. While consumers readily embrace science and technology in numerous parts of their lives, when it comes to their food, they tend to remain guarded. They hold idealized nostalgic narratives of food sourced as close to nature as possible and associate technology with processing and adulteration (even as they celebrate the progress it has enabled). These tensions between nature and science/technology are at the heart of the question of consumer adoption of new technologies. Fortunately, these tensions are evolving and represent a unique opportunity for the food industry.

“ *We've come to this place of need for food innovation through technology through centuries of poor choices that have led to problems with the planet, endangered species, climate change. I feel more hopeful because there are people working on solutions, but then I think, but we are forced into having these solutions because of these problems we've created. (Female, 60)* ”

Consumers are coming to see science as a necessary solution for global issues

A MOUNTING SENSE OF URGENCY AROUND THE CHALLENGES FACING THE FOOD SYSTEM is helping to soften consumer resistance to science and technology in food. Over the past several years, consumers have been increasingly confronted with the realities of issues such as climate change, pollution, food waste, the impacts of industrial food production on animal welfare and human health, the vulnerabilities of the global food system, and the impending challenges of feeding a growing world population. The dawning recognition that approaches of the past, however idyllic, are ill-equipped to address present and future threats is shining an increasingly positive light on the potential of scientific and technological innovation. Millennials are even more positive about these possibilities.

Views on Science and Innovation in Addressing Problems in the Food System (compared to 2019)



We need to find ways to meet our society's nutritional needs with fewer resources like energy, water, or carbon



Science and technology are our best hope to address climate change



Scientific and technological innovations can make food more sustainable



Scientific and technological innovations can make food more healthy



I'm willing to drastically change my lifestyle to live in a more environmentally friendly fashion

GMOs ILLUSTRATE THE EMERGING OPPORTUNITY FOR FOODTECH

Evolving consumer perspectives on GMOs reflect the opportunity for companies to develop meaningful narratives for food technology that help justify the *why* behind it. GMOs are beginning to shed their baggage as a new generation of consumers — many of whom did not experience the well-publicized battles over GMOs in the 1990s — comes to understand more about them and what benefits they offer. Consumers are developing more nuanced understandings of how food is produced and the potential for science and technology to improve the food system — when used for “the right” reasons. This shift in perspective points to a potential alignment between the underlying goals and benefits of new food technologies and consumer desire for a more sustainable and equitable food system. The power of *why* — transparency, understanding how the ends justify the means — can go a long way toward building openness and acceptance.

Precision fermentation is particularly well positioned to connect with and empower consumers

THE GOOD NEWS FOR THE FOOD INDUSTRY IS THAT WE NOW HAVE THE UNIQUE OPPORTUNITY TO OFFER CONSUMERS INNOVATIVE AND EXCITING WAYS TO ADDRESS THESE CHALLENGES — without requiring them to make fundamental changes to their habits and lifestyles. A growing chorus of emerging tech-forward food companies is making a case for new methods of food production that promise to address and transcend the limitations, excesses, and abuses of the current food system while creating a more equitable and just food system. For consumers, these issues can feel overwhelming and disempowering, but technologies such as precision fermentation can offer a sense of agency. But what is precision fermentation, and how do consumers make sense of it?

At its most basic, precision fermentation is an evolution of the centuries-old process of fermentation, updated with 21st century technology and science. *Rather than using animals, precision fermentation uses yeast and other micro-organisms that are enhanced through science to convert minerals or plant matter into ingredients such as proteins and sweeteners.* Unlike plant-based meat and protein alternatives, precision fermentation doesn't seek simply to provide analogues to animal-based foods; rather, it produces true-to-nature ingredients — indistinguishable in taste, texture, and nutrition — made at a fraction of the environmental footprint of conventional versions. And although it uses genetically engineered microflora to produce these ingredients, the microflora are filtered out and not present in the end products. *As novel as this process may sound to consumers, precision fermentation has already been used for years to produce a range of products many people already have in their homes, such as non-animal rennet for cheese-making, sweeteners, flavors, and many vitamins.*

For consumers, however, precision fermentation is new, and as with many new, unfamiliar technologies, education is key.



A little education goes a long way toward driving purchase intent

EDUCATION HAS A POWERFUL, POSITIVE IMPACT on consumer interest and likelihood to purchase. At present, familiarity with novel food production technologies such as cultivated meat and precision fermentation is low, particularly when compared to plant-based meat alternatives. Cultivated meat has also enjoyed more media coverage over the past several years, which likely accounts for consumers' relatively greater familiarity with it. Initially, lack of familiarity translates into lower initial purchase intent. Consumers are understandably skeptical and wary of unfamiliar food production technologies, expressing concern about potential downsides and unintended consequences emerging from them. What sets precision fermentation apart from other emerging technologies, however, is just how strong an impact a little education can have. Just a short description yields a significant and substantial increase in purchase likelihood — a jump neither plant-based meat alternatives nor cultivated meat can boast. The lift effect is even more pronounced among Gen Zs. (Millennials rank high in purchase intent to begin with.) In part, that's because precision fermentation benefits from an inherent

Likelihood to purchase

Among total without milk allergy



Familiarity (know a little/know a lot) with...



Likelihood to purchase without vs. with simple description

58% ➔ 60%

48% ➔ 46%

43% ➔ 56%

familiarity and positive halo; the term “fermentation” cues both a known process (as in making beer and wine) and one associated with healthy, natural products, such as yogurt, kimchi, and kombucha. Ultimately, consumers are better able to grasp precision fermentation than more disruptive technologies such as cultivated meat.

Likelihood to purchase *if familiar*

Among those who know a little / a lot, without milk allergy

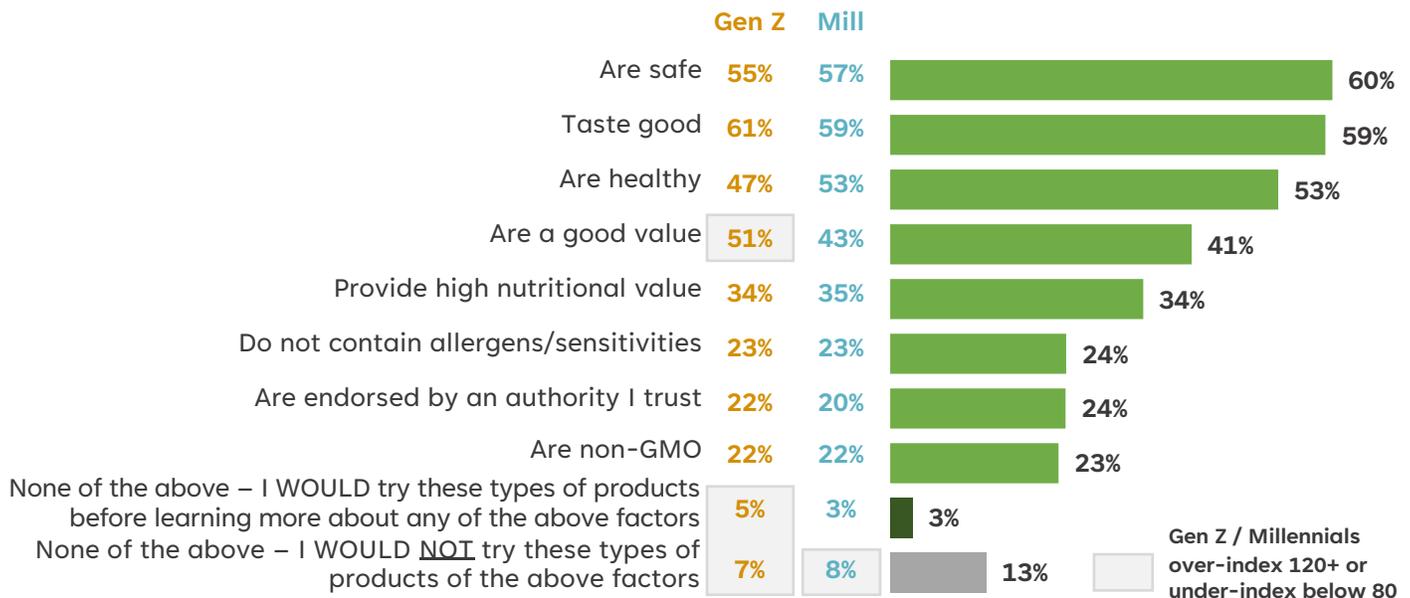


Reassuring consumers on safety and taste will be key to driving trial

There’s a reason why familiarity helps drive purchase intent: consumers’ comfort with and ability to make sense of tech-forward food shapes their openness to it. Overall, for new products made with “innovative methods,” consumers rank taste (67%) above safety (62%) as table-stakes issues. However, for precision fermentation, safety (60%) is just as crucial as taste (59%). This isn’t surprising, given its novelty. Concerns about short- and long-term health consequences mingle with questions about how processed ingredients made using precision fermentation are, echoing consumer aspirations for minimal processing and the absence of negatives such as artificial and unfamiliar ingredients.

Table stakes for precision fermentation trial: I would need to know PF products...

Among total without milk allergy



Being “a good value” is also important, particularly for Gen Z, who are just starting to forge their own paths and purchase decisions. But value isn’t limited just to price. For products to make it into consumers’ regular repertoires, they will need to offer certain advantages over existing options. When compared to conventional products, those made via precision fermentation would need to taste as good or better (52%), be better for the environment (37%), and provide higher nutritional value (36%). Fortunately, precision fermentation is already well positioned to demonstrate parity, if not superiority, with existing options.

“It’s hard for me to decipher whether this process is natural or not. For me, if it’s deemed safe by the FDA, then I wouldn’t necessarily have an issue whether it’s natural or genetically engineered. (Male, 49)

Environmental benefits, combined with education, help seal the deal for consumers

Sustainability can be hard for consumers to understand and address. Sure, they can aspire to waste less food, move away from plastics, even support companies that claim to reduce their carbon footprint. But global issues such as climate change and food insecurity can feel too big, too far outside the scope of individual behaviors to be tackled.

Among the benefits of production methods such as precision fermentation is that they align well with the kinds of environmental benefits that consumers desire. More than one-third (37%) of consumers say that food or beverages made using precision fermentation would need to be better for the environment than similar conventional products for them to consume them on a regular basis — second only to superior taste (52%). Among those who would want to see superior environmental benefits, minimizing greenhouse gas

emissions (38%), protecting natural habitats and wild species (38%), and minimizing pollution (37%) rank at the top. Products made using precision fermentation can thus offer consumers a sense of empowerment, a way of acting on big issues such as climate change without giving up familiar and favorite categories. This is particularly pronounced with dairy, a category imbued with powerful emotions and positive health associations but weighed down by baggage such as animal welfare concerns and high environmental impact. Learning basic information about the precision fermentation process and about its animal welfare and environmental benefits raises purchase intent significantly (63% and 70%, +22 pts and +30 pts, respectively). Education plus environmental benefits also boost purchase intent for stevia made through precision fermentation — by +29 pts to 69%.



I'd have questions and want additional information, such as what's involved in the process, [but] my immediate reaction to the idea of a company developing a more sustainable way of producing a food product I love would be, 'How wonderful, I'd like to try it.' (Female, 50)

Most relevant environmental benefits

Among those who said foods containing ingredients made using precision fermentation would have to be BETTER THAN CONVENTIONAL PRODUCTS to consume them on a regular basis



Receptivity to food and beverages made using precision fermentation is high across multiple categories

The prospects for precision fermentation are strong. If manufacturers meet consumers' expectations — safety, taste, health and nutrition, environmental benefits — they will be well positioned to take a central place in consumers' diets, particularly those already interested in innovative products. Consumers find it easiest to envision ingredients made from precision fermentation in smaller, more functional categories, such as protein power, drinkable yogurt, protein bars, and energy drinks. Still, even more broadly consumed categories such as ice cream and milk show at least some level of purchase intent, with around 7 or 8 in 10 consumers (respectively) saying they are at least somewhat likely to purchase products containing ingredients made using precision fermentation. Across the thirteen categories tested, Millennials are on average 6 percentage points more likely than all consumers to purchase products containing ingredients made using precision fermentation. This difference is more substantial in the milk category, where 84% of Millennials say they would be likely to purchase (vs. 70% among all consumers and just 50% among Boomers).



Likelihood to purchase food and beverages with ingredients made using precision fermentation (extremely, very, somewhat likely)

Among past-3-month category users without milk allergy



The size of the prize for precision fermentation is substantial



40% of US adults (over 90 million people) are immediately ready to try precision fermentation with minimal education efforts

WITH AN EFFECTIVE EDUCATION CAMPAIGN, NEARLY 100 MILLION CONSUMERS CAN BE INTERESTED IN FOOD AND BEVERAGES MADE USING PRECISION FERMENTATION TODAY.

Those most eager to try just about any innovative food will need the least convincing, while those more cautious, yet still open to innovation, will need to know a bit more about the personal and societal benefits. Moreover, nearly half of consumers would be willing to pay more for products that include ingredients made using precision fermentation. Those who already express likelihood to purchase see the value in such products and are more open to paying a premium for them — 6 out of 10 are willing to pay more and nearly 3 out of 10 are willing to pay 25% more or higher. What is even more encouraging is that Gen Z and Millennial consumers are both more willing than the general population to pay a premium.

Adoption Curve for PF Products

Among total

- 15%** *Ready*
Top 2 box (extremely/very) likely to purchase before reading anything about PF
- 11%** *Easily convinced*
Top 2 box likely to purchase after reading a brief description
- 14%** *Convinced with benefits*
Top 2 box likely to purchase after reading a benefit statement

Within these segments, three sub-groups stand out as potentially strong targets, all sharing urban and higher income skews:

- 59% of parents with kids 0-12
 - 58% of Hispanics
 - 44% of males
- } are *Ready* or *Open to Purchase*

In the next five years, both a growing Gen Z cohort and growing consumer comfort with food technology will expand the precision fermentation market

PRODUCTS MADE USING PRECISION FERMENTATION WILL HAVE A POTENTIAL MARKET SIZE OF OVER 132 MILLION CONSUMERS BY 2027 — if they meet

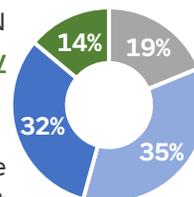
expectations around safety, taste, health and nutrition, and other key benefits. Over a third of US adult consumers consider themselves early adopters of food technologies. Younger consumers, in particular, represent ideal targets. Millennials are the most forward-leaning cohort when it comes to early adoption, aligning their values and behaviors. Gen Z, too, can be expected to follow suit as they mature and gain independence. Millennials are also the most likely group to replace all or most of their current product lineup (19%), and Gen Z over-index in expected regular use of products made through precision fermentation (39%).

Likely role of PF products within consumers' overall food and beverage portfolio

Among likely to purchase, no milk allergy

I'd buy the products containing ingredients made using PRECISION FERMENTATION

occasionally



I'd continue buying only the traditional products I currently use

I'd regularly replace some of my current products with ones that contain ingredients made using PRECISION FERMENTATION

I'd replace all or most of my current products containing ingredients made using PRECISION FERMENTATION



I feel like now, with the technology we have nowadays, we should be able to get our food a lot more efficiently and in more sustainable ways, so we're not overproducing or wasting excessively and things like that. Like, technology, if we were to put more effort towards that area, we could be a lot more efficient with the things we have here on this planet. (Male, 21)

The most compelling value proposition lies at the intersection of “good for me” and “good for society”

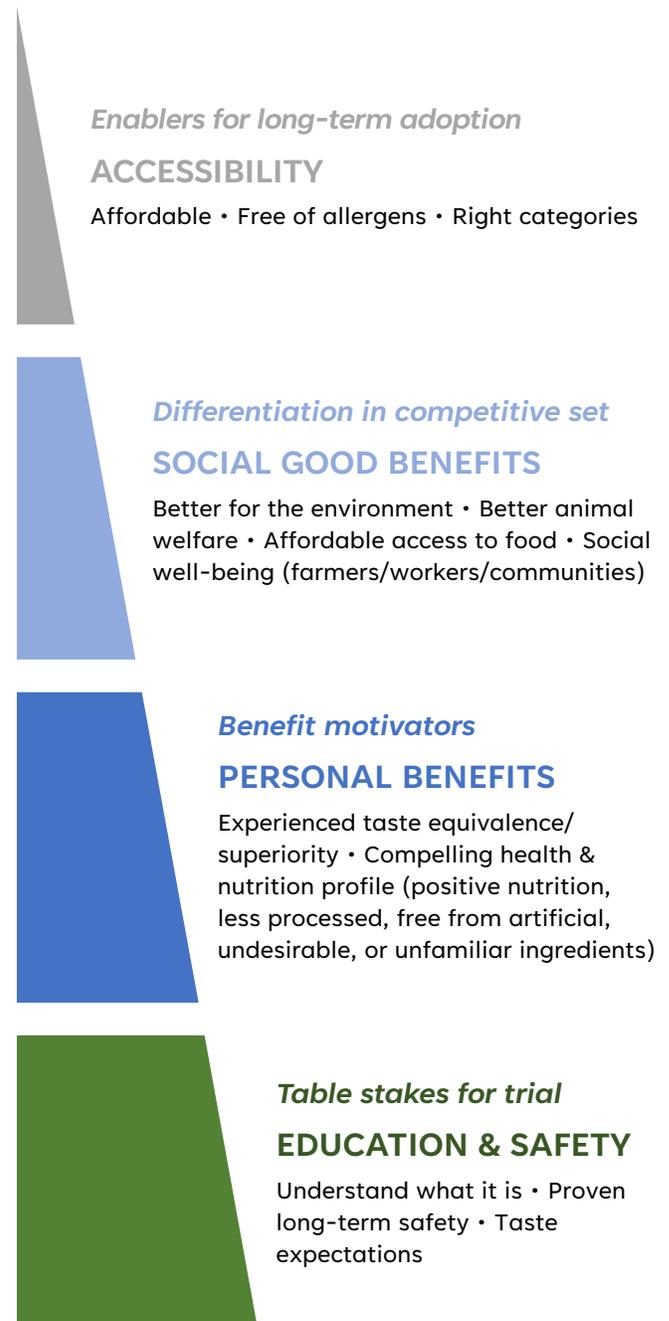
Science and technology in food are becoming more acceptable to consumers thanks to a growing understanding that we need to do better to feed the planet in a sustainable manner. Companies’ values around sustainability and ethics are increasingly important to consumers, particularly Gen Z and Millennials, who want to support those they see as truly caring.

“ I would be really excited to find out that some sort of improvements were being made on the production process that was making food more sustainable and have less of an impact on the environment. I think that’s the direction companies need to be going. I think the biggest hurdle to overcome is explaining why it’s actually good and getting buy-in from consumers that it actually was a change. (Female, 41)

However, concerns about environmental and social good will not drive adoption of food innovations on their own. To demonstrate the value of tech-forward products, companies will also need to address consumers’ personal food and beverage needs and priorities — such as taste, health, and nutrition. **Ultimately, manufacturers and retailers will need to demonstrate the purpose, humanity, and value of such innovations.**

THE PRECISION FERMENTATION FOOD PYRAMID

These drivers bucket the motivations and barriers that reflect consumers’ essential criteria for adopting precision fermentation

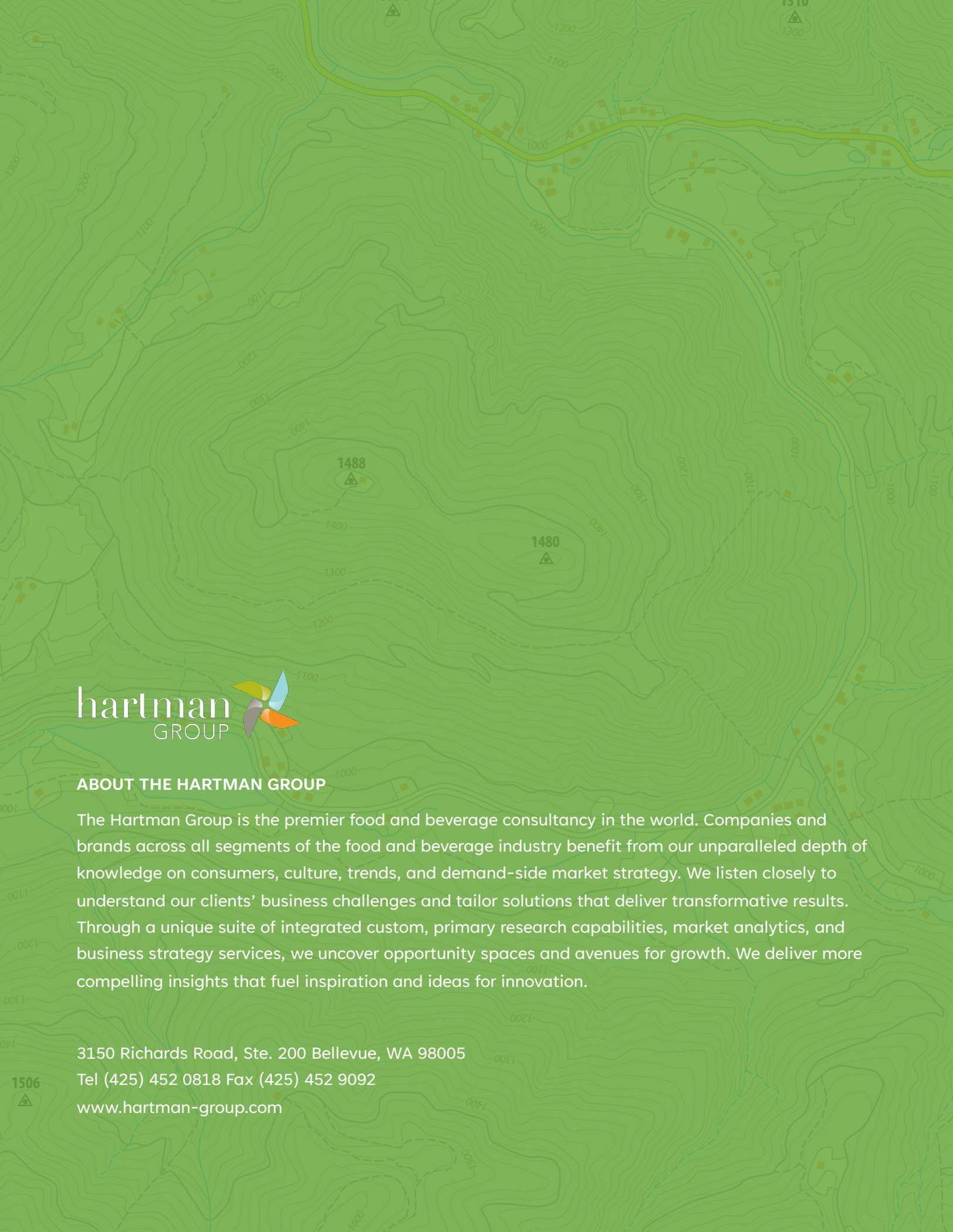


Final Thoughts and Recommendations

This is a pivotal moment for tech-forward foods, and the food industry has a powerful opportunity to be at the vanguard of a paradigm shift in food production. Precision fermentation has applications across a number of food and beverage categories that companies can tap to differentiate themselves in a competitive market among consumers calling for change and empowerment.

- Ensure consumers clearly understand the *why* behind innovations. A compelling framework for innovation can build on the idea of science and technology in the service of nature. Align products and brands with the values underlying consumers' ideals of "natural" food: **connection, care, simplicity, stewardship, resilience.**
- Connect with young consumers now — particularly Gen Z — to help them understand the value of precision fermentation and drive adoption of foods made using precision fermentation when they begin charting their own path. The good news is that demand exists, now and in the future.
- Prioritize formulating "clean" products with shorter, simpler ingredient lists and comparable, if not superior, health and nutritional benefits, when possible. Consumers will still draw on their desire for "clean" and healthy food when evaluating new products made through precision fermentation.
- Although taste and product performance will be crucial for mainstream adoption, explore opportunities for innovative flavors, formats, and experiences that offer novelty, excitement, and discovery.
- Integrate products that are made using precision fermentation into existing store categories (rather than creating separate sections) using an "integrated-segregated" merchandising approach. In many instances, there is an opportunity to integrate these products with high-velocity traditional sets so consumers come across them naturally while creating new "planet positive" sets to help spur interest and trial.





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ABOUT THE HARTMAN GROUP

The Hartman Group is the premier food and beverage consultancy in the world. Companies and brands across all segments of the food and beverage industry benefit from our unparalleled depth of knowledge on consumers, culture, trends, and demand-side market strategy. We listen closely to understand our clients' business challenges and tailor solutions that deliver transformative results. Through a unique suite of integrated custom, primary research capabilities, market analytics, and business strategy services, we uncover opportunity spaces and avenues for growth. We deliver more compelling insights that fuel inspiration and ideas for innovation.

3150 Richards Road, Ste. 200 Bellevue, WA 98005

Tel (425) 452 0818 Fax (425) 452 9092

www.hartman-group.com