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Next steps for probiotics

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Effectively delivering probiotics in food and beverage applications

by Judie Bizzozero

INSIDER's Take

- Probiotic strains are unique, and their properties may influence efficacy and suitability for certain applications.
- Various manufacturing processes can impact probiotics' physiological effects in food and beverages.
- Water activity plays a key role in managing probiotic stability and viability in solid food formats.

The probiotics category continues to evolve as consumer interest in the microbiome and overall gut health fuels demand. As a result, researchers are discovering new health benefits of probiotic strains, while manufacturers improve technologies and techniques to drive solutions. Developments such as spore-forming probiotics and microencapsulation have made probiotics more resistant to processing, inspiring a host of innovative delivery formats, especially in foods and beverages.

Not all strains are created equal

Probiotic strains possess distinct characteristics. Each one is unique, and these properties may influence safety, efficacy and suitability for certain applications.

For beverages, the form of the probiotic strain is dependent on the finished product type and distribution channel. For example, live and active cultures are generally used in refrigerated products such as drinkable yogurt, kefir and kombucha, while the more robust spore form of microorganisms is often used in nonrefrigerated beverages, noted Joe Farinella, vice president of research and development (R&D), Imbibe.

"In terms of specific strains, yogurt drinks are made by adding lactic-acid-producing bacteria, such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, into a dairy base and fermenting at elevated thermophilic temperatures," he said. "These strains do not survive the digestive tract, so yogurt drinks can be fortified with additional, hardier organisms like bifidobacterium and other forms of lactobacillus to deliver increased probiotic effect."

Kefir drinks contain similar bacteria strains to yogurt; however, they also contain various yeast strains (e.g., *Candida humilis*, *Saccaromyces unisporous*), Farinella explained. Kombuchas contain a more elaborate cocktail, including bacteria (e.g., *Acetobacteria*, *Aluconacetobacter*) and yeasts (e.g., *Saccaromyces*, *Zygosaccharomyces*).



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“Engineered” probiotic drinks, like Kevita probiotic soda, contain the spore form of bacteria, such as *Bacillus coagulans*. “The spore form is much more robust and not only can survive higher temperature exposure from the production process, but also survive in acidic environments and are more likely to reach the intestine,” Farinella added.

John Quilter, Wellmune’s vice president and general manager, Kerry, said *Bacillus coagulans* are much more resistant to the extremes of pH, heat, cold and pressure than vegetative cells, making them a great fit for the fortification of everyday foods and beverages.

GanedenBC30 (*Bacillus coagulans* GBI-30, 6086) is a patented, GRAS (generally recognized as safe) probiotic ingredient from Kerry found in more than 900 food and beverage products. The shelf-stable probiotic strain has been shown to provide digestive health,¹ immune health² and protein utilization benefits.¹ GanedenBC30 is a spore former, which allows it to remain viable throughout most manufacturing processes and the low pH of stomach acid.

“GanedenBC30 can be used in products that are hot, cold, frozen or shelf stable, making them ideal for a wide range of products, including baked goods, frozen and chilled meals, snacks, and hot and cold beverages.” Quilter said.

Formulation

Formulating foods and beverages with probiotics requires a fundamental understanding of food and beverage formulation, and how manufacturing impacts probiotics’ physiological effects, noted Kantha Shelke, principal, Corvus Blue LLC.

According to the World Health Organization (WHO), “Probiotics are microorganisms that need to be alive when administered and need to be administered in amounts adequate to have a health benefit.”



Food and beverage products must fulfill several criteria to ensure probiotics meet their definition. According to the World Health Organization (WHO), “Probiotics are microorganisms that need to be alive when administered and need to be administered in amounts adequate to have a health benefit.” Shelke said the definition does not stipulate what an adequate amount is. However, regulators in, for example, Canada and Italy require a minimum dose of 10⁹ colony-forming units (CFUs).⁴

“Meeting these criteria is particularly challenging in food and beverage formats because the associated processes can be harsh, and the ingredients can challenge viability, yield and often even the selection of the culture media ingredients (and therefore, the type of microorganisms) because of allergen issues for optimized dosage and functionality, even at the end of shelf life,” Shelke said.

Farinella said ensuring an effective dose of probiotics from production through purchase and consumption is the biggest challenge to formulating probiotic beverages. Live, active cultures used in refrigerated products are sensitive to the high temperatures needed during the manufacturing process, while the spore form of bacteria tends to be stable in high-temperature conditions. In both cases, he said, it is important to overdose the product with probiotics during the batching step in order to ensure delivery of the desired amount post-production.

“The exact overdose levels are product- and process-dependent, so be sure to consult your ingredient suppliers and prepare to perform multiple trials at various levels in order to ensure you achieve the label-stated dosage,” Farinella said. “Degradation of probiotic levels also can occur while a product is in distribution and on shelf, so it is important to perform shelf-life studies and measure the actual amount that will reach the consumer.”

Quilter noted many strains are fragile and sensitive to processing conditions, limiting their use to products in the refrigerated dairy category. “However, the ability of spore formers to form a protective shell allows them to withstand beverage processes such as powder-blending, HTST [high temperature/short time] and HPP [high-pressure processing] pasteurization, boiling and freezing,” he said. “One of the few formulation challenges with spore formers is in shelf-stable liquid beverages, but some of our partners have found solutions through cap dispensers and straw technologies.”

Shelke said *Lactobacillus* and *Bifidobacterium* genera have a long tradition as starter cultures in yogurt and fermented dairy production. The right balance between clinical dose, shelf life and cost efficiency is a function of strain type, pH, fermentation temperature (affects probiotic growth), storage temperature, packaging type (oxygen transmissibility), processing steps (heat treatment and homogenization) and interaction with other ingredients (fruits, grains and sweeteners—all of which can be particularly detrimental to probiotic survivability).

Maintaining viability of foods fortified with freeze-dried strains also is a challenge, cautioned Shrilakshmi Desiraju, Ph.D., founder and CEO, Triphase Pharmaceuticals Pvt. Ltd., but one that can be overcome by using temperature-stable probiotic (TSP) strains. “Our TSP strains can be formulated/incorporated at the right point during processing to provide a shelf life of 18 months at room temperature with low water activity,” she said.



“Not all probiotics are suitable for every food and beverage application


because they can affect the taste and texture of the products. Traditional *Lactobacillus*, commonly used in yogurts, are not necessarily suitable for kombucha, bars and cereals.”

— Fabian Skarvad, sales director, functional food, Probi

Fabian Skarvad, sales director, functional food, Probi, said not all probiotics are suitable for every food and beverage application because they can affect the taste and texture of the products. “Traditional *Lactobacillus*, commonly used in yogurts, are not necessarily suitable for kombucha, bars and cereals.” Skarvad also said shelf life is one of the biggest challenges for functional beverages because live and active bacteria are sensitive to ambient distribution and sales considerations.

Trending strains and delivery formats

The prevalence of foods and beverages containing probiotics is rising steadily with growing “pill fatigue” and the perception that consuming probiotics in a food is more natural and effective. According to Shelke, the shelf life of probiotic nondairy foods is distinctly shorter than that of dietary supplements because of harsher matrices and factors such as pH, acids and anthocyanins, and that the probiotic is in a vegetative rather than in a freeze-dried state.⁵ A combination of technologies, such as refrigeration and pH balance, help maintain viability while avoiding metabolic activity of the probiotic and spoiling of the juice or the fermented medium, such as kombucha, or the fluid format as nondairy plant-based yogurt analogues.



In traditional probiotic foods such as yogurts and other fermented milk products, the matrix for carrying probiotic health benefits is the product itself, and fermentation provides cost-efficient cell counts.

In shelf-stable beverages, secondary packaging that segregates probiotics in a separate compartment, such as a bottle cap or a straw, help protect and release the proper dosage immediately before consumption, Shelke said.

Water activity plays a key role in managing probiotic stability and viability in solid food formats such as breakfast cereals, chips, chocolate, confectionery, crackers, snacks, peanut butter and crispy granola bars. “In general, the water activity should be less than 0.25 to meet a 12-month shelf life at 25° C,” Shelke noted. “Chocolates and peanut butter products are an exception to this water activity guideline because their fat-based matrixes can support probiotic stability with water activities up to 0.4.”

Ice cream can keep probiotics viable for more than one year. “It is important to keep the ice cream base at neutral or close to neutral pH, with high total solids, and, especially, fat content,” Shelke said, adding overrun is an issue for highly aerated ice creams, which can disturb the probiotic with the increased exposure to oxygen.

Cheese is another emerging format for strains such as *Lactobacillus acidophilus* NCFM (HOWARU Dophilus by DuPont), *Lactobacillus paracasei* Lpc-37 (FloraFit, DuPont), and *Lactobacillus rhamnosus* HN001 (HOWARU, DuPont). Shelke said



these can be included in standard cheeses like gouda and cheddar with cell counts in excess of 108 CFU/g even after 200 days, so that a serving of 10 g of cheese would be sufficient to obtain the desired daily dose.

Probi's *Lactobacillus Plantarum* LP299v strain is being used in a range of products, including fermented fruit and vegetable drinks, sparkling and infused beverages, and traditional dairy and plant-based products. "Fermented plant-based products with a functional benefit is where we foresee the market growth in the coming years," Skarvad said.

Desiraju pointed to increased use of *Lactobacillus acidophilus*, *Lactobacillus rhamnoses* and *Lactobacillus plantarum* strains in gummies, chocolate, muffins, cookies, breads and oral patches.



Fermented products

In traditional probiotic foods such as yogurts and other fermented milk products, the matrix for carrying probiotic health benefits is the product itself, and fermentation provides cost-efficient cell counts, Shelke said, noting utmost care is required to ensure the probiotic culture does not compromise the sensory profile of the product.

"Dedicated and strict hygiene standards is probably the only way sensory aspects and safety can be controlled in these products," she noted. "Suppliers of probiotics have found that frozen pellets rather than lyophilized/milled probiotic powders allow for homogeneity of the product and reduced mixing time without the wettability and dispersion issues with the powdered probiotics."

Desiraju said fermented products can create challenges, including the loss of beneficial bacteria, threat of botulism contamination and spoilage.

The pasteurization process used in the production of some fermented foods will destroy almost all living bacteria, and even raw, nonpasteurized fermented foods may not be backed by sufficient evidence to be considered "probiotic," Quilter said.

According WHO, probiotics are live microorganisms that confer a health benefit. By contrast, fermented dairy products—depending on storage conditions, cultures used and other manufacturing processes—may contain only a small fraction of the active cultures added at the time of manufacture, and probably not enough to confer a health benefit, Quilter advised.

"Manufacturers who want to promote the probiotic benefits of their foods or beverages should fortify them with high-quality, resilient, science-backed probiotic strains," he said. "It is important to work with ingredient suppliers that provide well-researched strains, but also have research and development support."

What's NEXT?

There's no doubt functional food and beverages will continue to trend with health-conscious consumers, and the proof is on the shelf. Brands are rolling out innovative probiotic-rich products, according to proprietary data from Informa Markets' NEXT Trend Database, which tracks all products exhibited at the Expo West and Expo East trade shows. NEXT data found dairy milks with probiotic claims share of growth



increased an impressive 1,019% between 2017 and 2019, followed by snacks, cookies and candy (314%) and dairy and plant-based yogurt (23%).

The breakfast category presents opportunity as well. Packaged Facts' ["U.S. Food Market Outlook 2019"](#) report found cereal-makers have joined other food categories incorporating probiotics and other gut-healthy ingredients into new products.

Kellogg's HI! Happy Inside cereal promotes digestive wellness with prebiotics, probiotics and fiber. The cereal contains 1 billion CFUs of live probiotics from active strains, 2.5 g of prebiotics and 8 to 9 g of fiber. Available in three flavors, the cereal is a blend of fruit, yogurt pieces and 100% whole grains. It was developed at WK Kellogg Institute for Food & Nutrition Research. Prior to introducing HI! Happy Inside, Kellogg launched Special K Nourish cereal with probiotics. At launch, Kellogg's said Special K Nourish was the only cereal from a leading brand that contained live and active probiotic cultures. In addition to probiotics, the cereal contains whole grains, peach-flavored flakes, blueberries, raspberries and yogurt pieces.

ThinkThin's line of protein and probiotic hot oatmeal also promotes overall wellness and digestion with 6 g of fiber, 10 g of protein and 1 billion CFUs of live probiotics. The products are non-GMO, gluten-free and have no artificial flavors or sweeteners.

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Natural Products EXPO EAST® Probiotics chalk up big win

Keenan Smith, founder and CEO of [Goodwolf](#), took home the top prize at the 2019 Natural Products Expo East Pitch Slam. Goodwolf makes water kefir, a raw, living probiotic drink from traditionally fermented kefir crystals. Capitalizing on two fast-moving categories—fermentation and sparkling water—Smith, a former natural foods sales broker, decided to put his energy and expertise into his own company. [Click here](#) to watch him explain the origins of kefir crystals, as well as the legend of the two wolves and the evolution of the Goodwolf brand.

