news digest #013

Potential of *L. plantarum* in the food industry

If you're a foodie, you've probably heard of *Lactiplantibacillus plantarum* - a gram-positive, bacilli-shaped bacterium, member of the widespread genus *Lactiplantibacillus*. The genus and its contribution to yogurt formation were first identified in 1905 by the Bulgarian Doctor Stamen Grigorov.

This bacterium is commonly found in a wide variety of environments, such as foods and animal feeds, including dairy, meat, fish, fermented vegetable products, and even in the human gut. *L. plantarum* is listed under the "generally recognized as safe" (GRAS) food category by both the European Food Safety Authority (EFSA) and the United States Food and Drug Administration (FDA).

L. plantarum is an incredibly intriguing organism that has attracted significant interest from both industry and academia. In addition to its well-known role as a fermentation starter and food preservative, it has an important role as a probiotic bacterium as well (Zheng J. *et al.*, 2020). However, it's crucial to note that the beneficial probiotic effects and starter properties of *L. plantarum* are strain-dependent and not universally shared throughout the species. This has led to the need for a technology that can quickly and reliably identify different strains of *L. plantarum*.

Both industry and academic laboratories are looking for a technology capable of strain discrimination, that is at the same time efficient, fast, reliable, and cost-effective. In this context, instruments based on Fourier Transform Infrared (FTIR) spectroscopy such as Bruker's IR Biotyper® are proving to be more suitable than DNA-based technologies.

Recent studies have shown that FTIR technology can play a crucial role in the characterization of *L. plantarum* after strain isolation, discrimination, and cultivation - particularly in industrial production (Deidda F. *et al.*, 2022; Xiaoqiong Li *et al.*, 2022).

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L. plantarum as a fermentation starter and food preservative

Among the lactic acid bacteria, *L. plantarum* boasts a wide range of applications. Not only has it been used for centuries as a starter culture for fermenting foods, but it is also commonly added to food products such as bread and wine to enhance their flavor, texture, and organoleptic properties (Cui Y *et al.*, 2014). As a bonus, *L. plantarum* produces several bioactive and beneficial components like exopolysaccharides, γ-aminobutyric acid, riboflavin, folic acid, and vitamin B12, which contribute to the functional properties of fermented foods.

But perhaps the most important application of *L. plantarum* is its ability to maintain food safety and prevent spoilage. During fermentation, *L. plantarum* not only reduces the amount of undesirable compounds such as aflatoxins, but also produces organic acids and bacteriocins (antibacterial peptides) that exhibit excellent food preservative properties. In fact, the bacteriocins produced by *L. plantarum* have demonstrated a broad spectrum of antimicrobial activity against foodborne pathogens, such as *Listeria monocytogenes*, as well as food spoilage bacteria.

Given the growing demand for additive-free foods, there is a great need for bio-preservatives such as *L. plantarum*. This is where systems like Bruker's IR Biotyper® come in handy, as they enable the identification of *L. plantarum* strains with the highest activity as both fermentation agents and food preservatives. This technology has enormous potential for industrial applications, ensuring that consumers can enjoy safe, healthy, and tasty foods.

L. plantarum and its probiotic properties

In recent decades, there has been a significant surge in the consumption of probiotics. These are live microbial supplements that, when taken as a dietary supplement, can positively impact the consumer by restoring or enhancing the balance of the intestinal microbial flora. The selection of a probiotic is crucial, and the FAO/WHO has outlined several criteria that must be met. These include the ability to survive in high numbers, withstand the harsh environment of the digestive system, and produce antimicrobial substances that can combat pathogens or have the capability to modulate the immune system response of the host (Fijan S. *et al.*, 2014).

Lactic acid bacteria (LAB) and *Bifidobacterium* spp. are widely recognized as some of the most effective probiotic microorganisms. They possess dynamic nutritional value and have the potential to provide numerous health benefits to humans. However, recent research suggests that the properties of these probiotic bacteria are highly dependent on the specific species and even the individual strain used (Dempsey E. *et al.*, 2022).

Among the probiotic lactic acid bacteria, *L. plantarum* is a well-known and widely used lactic acid bacterium that is also classified as generally recognized as safe (GRAS), making it an ideal candidate for industrial use as a probiotic. This microorganism has gained immense popularity in recent years, due to its numerous beneficial properties. Specifically, selected strains of *L. plantarum* have been applied in the medical field for the treatment of various chronic and cardiovascular diseases, such as Alzheimer's, Parkinson's, diabetes, obesity, cancer, hypertension, urinogenital infections, liver disorders, and more (Woo J.Y. *et al.*, 2014). The versatility of this probiotic microorganism makes it a valuable asset for various health-related applications.

A quality control solution for *L. plantarum* production

Lactiplantibacillus plantarum has emerged as a top contender for a variety of applications, ranging from serving as a starter culture to functioning as a probiotic microorganism in the food industry. This versatility has piqued the interest of numerous industries, sparking an increase in large-scale production.

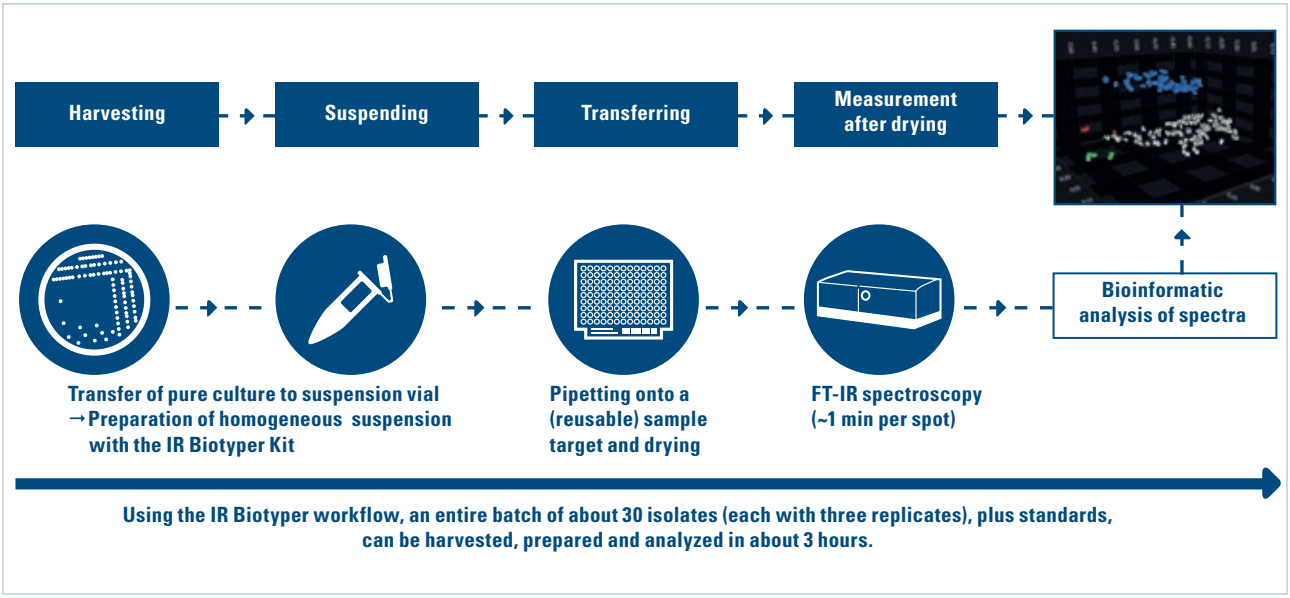
With the properties and benefits of *L. plantarum* being very strain-specific, an easy-to-use method for fast, reliable and effective strain discrimination of *L. plantarum* is highly desirable, for both academic and industrial purposes (Fuhren *et al.*, 2020).

Fortunately, Bruker's IR Biotyper® system utilizing FTIR technology shows (large) potential as an ideal solution for this need. It offers a promising alternative to DNA-based technologies that have traditionally been used for *L. plantarum* discrimination.

The advantages of the IR Biotyper® system over DNA-based technologies have been demonstrated in recent studies (Li X, *et al.*, 2022). Notably, Bruker's FTIR-based technology provides strain typing results that are equivalent to those obtained through the use of main DNA-based techniques, such as pulsed-field gel electrophoresis (PFGE), multi-locus sequence typing (MLST), and whole-genome sequencing (WGS). In addition, the use of DNA-based technologies is associated with higher costs, greater labor requirements, and longer processing times, making them less practical for routine use in large-scale production settings. As such, the IR Biotyper® system offers a more convenient and efficient solution for these applications (Quintelas *et al.*, 2018).

Compared to DNA-based technologies, another significant benefit of utilizing an FTIR system is its capability to identify alterations in the bacterial cell wall that may not always be attributed to genetic variations. This may pave the way for a typing process that is solely based on phenotypic characteristics, which is particularly useful for large-scale industrial production where bacteria may experience various stressful conditions that can modify their phenotypic characteristics rather than their genomic stability.

A recent study has highlighted that the FTIR technology can be a valuable and advantageous approach for real-time monitoring of the phenotype stability of *L. plantarum* strains during large-scale production processes (Deidda F. *et al.*, 2022).



IR Biotyper workflow in probiotics industry

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