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Mining Microbial Genomes for Rational Development of Plant-Based Food Starter Cultures

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Introduction.

Plant-based fermented foods (PBFFs) are rapidly gaining global popularity due to their health benefits and sustainability. However, traditional PBFF production, relying on spontaneous fermentation, often suffers from inconsistent quality, limiting industrial scalability [1,2]. This project addresses this challenge by developing a rational, data-driven approach to design optimized starter cultures for PBFFs, leveraging the power of genome mining.

Main Sections.

Our approach utilizes genome mining and bioinformatics tools (KEGG , antiSMASH) to identify microorganisms with enhanced functional traits relevant to plant-based fermentation [3]. Key traits include efficient carbohydrate, protein, and lipid metabolism, desirable flavor formation, robust stress tolerance, and vitamin biosynthesis [4]. Microbial candidates (lactic acid bacteria, yeasts, Bacillus spp.) are selected based on their genomic potential and rigorously validated through controlled fermentation studies with plant substrates (soy, pea) [5]. These studies involve detailed monitoring of metabolic profiles, flavor volatiles, and textural properties. We employ iterative optimization of microbial consortia, focusing on synergistic and complementary metabolic activities, to tailor starter cultures for specific product attributes, such as improved flavor, texture, and nutritional content, and enhanced safety and shelf-life [6].

Conclusion.

This research will offer a guide genomic strategy for the rational design of starter cultures, significantly enhancing the quality, consistency, and nutritional value of PBFFs. The project will bridge traditional fermentation practices with cutting-edge biotechnology. We will provide a scalable solution for the PBFF industry through an approach with potential to contribute to a more sustainable and secure global food system, meeting the increasing consumer demand for high-quality, plant-based alternatives, and advancing the PBFF sector towards greater industrial efficiency and product reliability.

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