

Characterization of Lactic Acid Bacteria Found in Fermented Cereal Products

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INTRODUCTION

Fermentation is one of the oldest and most widely practiced methods of food preservation and enhancement. It involves the action of microorganisms, primarily Lactic Acid Bacteria (LAB), on food substrates to produce a variety of fermented products. Cereal-based foods, such as bread, sourdough, and various porridges, have been fermented for centuries by these beneficial bacteria. In this article, we will explore the fascinating world of lactic acid bacteria, focusing on their role in fermenting cereal products and the characterization techniques used to understand their properties.

Lactic acid bacteria: Guardians of fermented foods

Lactic acid bacteria are a diverse group of gram-positive bacteria that produce lactic acid as a metabolic byproduct during carbohydrate fermentation. They have been employed in the production of fermented foods for thousands of years, playing a vital role in food preservation, flavor.

The LAB group includes several genera, with *Lactobacillus*, *Streptococcus*, and *Pediococcus* being some of the most well-known. Each of these genera comprises numerous species and strains, each with its own unique properties and fermentation capabilities.

The fermentation process in cereal products

Fermentation of cereal products involves the action of LAB and yeast species, which work in synergy to transform the raw cereal materials into flavorful and nutritionally enriched foods. The key stages of cereal fermentation include:

Leavening: In bread-making, LAB and yeast are responsible for leavening the dough. Yeast ferments sugars to produce carbon dioxide gas, which causes the dough to rise. LAB contribute to flavor development and acidity regulation during this stage.

Acidification: LAB produces lactic acid through the fermentation of carbohydrates. This acidification not only imparts a sour taste but also plays a crucial role in food safety by inhibiting the growth of spoilage microorganisms and pathogens.

Flavor development: LAB contribute to the development of complex flavors through the production of various volatile compounds, including organic acids, alcohols, and esters. These compounds are responsible for the unique and desirable flavor profiles of fermented cereal products.

Nutritional enhancement: Fermentation enhances the nutritional value of cereals by increasing the bioavailability of certain nutrients, such as minerals and vitamins. LAB can produce enzymes that break down complex molecules, making them more accessible for absorption.

DESCRIPTION

Characterization of lactic acid bacteria in fermented cereal products

Characterization of LAB in fermented cereal products involves the comprehensive study of their morphological, physiological, biochemical, and genetic characteristics. This characterization is essential for understanding their role in the fermentation process, ensuring product consistency, and potentially selecting strains with specific desirable traits for commercial applications. Here are some of the key aspects of LAB characterization:

Morphological characteristics: LAB can be characterized based on their size, shape, and cellular arrangement. Microscopy techniques, such as light microscopy and electron microscopy, are used to observe these characteristics. LABS are typically cocci (spherical) or rods, and their cellular arrangements can be chains, pairs, or clusters.

Physiological characteristics: Physiological characteristics encompass metabolic traits, such as the ability to utilize specific carbohydrates, produce specific metabolic products (e.g., lactic acid), and grow under specific environmental conditions (e.g., temperature and pH). These characteristics are typically determined through laboratory experiments and tests.

Biochemical characteristics: LAB can be further characterized through various biochemical tests, including carbohydrate fermentation profiles, enzymatic activities, and resistance or

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susceptibility to specific antibiotics. These tests help identify LAB at the species and strain levels.

Genetic characteristics: Molecular techniques, such as Polymerase Chain Reaction (PCR) and DNA sequencing, are widely used to characterize LAB at the genetic level. These methods allow for the identification of specific genes and sequences unique to different LAB strains.

Phenotypic characteristics: Phenotypic characterization involves assessing LAB for traits like acid production, exopolysaccharide production, antimicrobial activity, and stress tolerance. These characteristics provide insights into the functionality and potential applications of LAB strains.

Genomic analysis: Recent advancements in genomics have made it possible to conduct whole-genome sequencing of LAB strains. This in-depth analysis allows for a comprehensive understanding of the genetic makeup of LAB, including the presence of functional genes related to fermentation and other traits.

Importance of LAB characterization in cereal fermentation

The characterization of LAB in fermented cereal products serves multiple important purposes:

Quality control: Characterization helps ensure the consistency and quality of fermented products. By identifying specific LAB strains responsible for desirable attributes, producers can maintain product standards.

Food safety: LAB characterization helps confirm the dominance of beneficial LAB strains, which contribute to food safety by inhibiting the growth of harmful microorganisms. This is particularly crucial in preventing spoilage and pathogenic contamination.

Flavor development: Understanding the metabolic capabilities of LAB strains enables producers to select or manipulate strains that contribute to the desired flavor profiles of fermented cereal products.

Nutritional enhancement: LAB strains can be chosen or engineered to enhance the nutritional value of cereals by increasing the bioavailability of essential nutrients.

Strain selection: In industrial applications, LAB strains can be selected or genetically modified for specific purposes, such as the production of functional foods or probiotics.

Examples of LAB in fermented cereal products

LAB plays a pivotal role in a wide range of fermented cereal products around the world. Here are a few notable examples:

Sourdough bread: *Lactobacillus sanfranciscensis* is a key LAB species found in sourdough cultures. It contributes to the characteristic tangy flavor and leavening of sourdough bread.

Idli and dosa: In South India, fermented rice and lentil products like idli and dosa are prepared using *Lactobacillus acidophilus* and *Lactobacillus fermentum*, among others. These LAB strains help reduce the anti-nutrient content and improve the protein quality of the final products.

Kefir: Although not a cereal product per se, kefir is a fermented dairy beverage that can contain LAB strains such as *Lactobacillus kefirianofaciens*. These LAB contribute to the unique flavor and probiotic properties of kefir.

Togwa: Togwa is a fermented cereal porridge consumed in Tanzania. LAB strains, including *Lactobacillus plantarum* and *Lactobacillus brevis*, are responsible for its fermentation and preservation.

Injera: Injera is a sourdough flatbread from Ethiopia, where LAB strains like *Lactobacillus fermentum* and *Lactobacillus brevis* are essential for its fermentation and distinctive taste.

CONCLUSION

Lactic acid bacteria are the unsung heroes of the world of fermented cereal products. Their versatile metabolic capabilities, flavor-enhancing activities, and contributions to food safety make them invaluable in the production of a wide range of cereal-based foods. The characterization of LAB strains through morphological, physiological, biochemical, and genetic analyses provides insights into their functionality and potential applications in food production.

Understanding the role of LAB in cereal fermentation not only helps maintain product quality and safety but also opens the door to innovation in the development of new, nutritionally enhanced, and culturally diverse fermented cereal products. As we continue to explore the world of food microbiology, LAB will remain at the forefront, shaping the flavors and nutritional profiles of the foods we love.