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Research Article

EXPLORING THE PLANT GROWTH PROMOTION AND ANTAGONISTIC PROPERTIES OF LACTIC ACID BACTERIA: A COMPREHENSIVE STUDY

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ABSTRACT

Lactic acid bacteria (LAB) are known for their various beneficial properties, including plant growth promotion and antagonistic effects against plant pathogens. In this study, we aimed to explore the plant growth promotion and antagonistic properties of LAB isolated from various sources. The LAB isolates were screened for their ability to produce indole acetic acid (IAA), phosphate solubilization, siderophore production, and antagonistic effects against plant pathogens. The results showed that most of the LAB isolates exhibited plant growth promotion properties, with the ability to produce IAA and solubilize phosphate. Moreover, some of the LAB isolates also showed strong antagonistic effects against plant pathogens, such as Fusarium oxysporum, Pythium ultimum, and Rhizoctonia solani. The study suggests that LAB can be a potential biocontrol agent for plant diseases while promoting plant growth.

KEYWORDS

Lactic acid bacteria, plant growth promotion, antagonistic effects, indole acetic acid, phosphate solubilization, biocontrol.

INTRODUCTION

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Plants require the assistance of beneficial microorganisms to enhance their growth and development. Lactic acid bacteria (LAB) are among the microbial communities that have demonstrated potential for plant growth promotion and control of plant pathogens. This study aims to explore the plant growth promotion and antagonistic properties of LAB in order to provide insights into their potential applications in agriculture. Lactic acid bacteria (LAB) are well-known for their probiotic properties, as they can promote human and animal health through their beneficial effects on the gut microbiota. However, the potential applications of LAB in agriculture have received increasing attention in recent years. Several studies have reported that LAB can act as plant growth promoters and biological control agents against plant pathogens, making them a promising alternative to chemical fertilizers and pesticides.

In this study, we aimed to explore the plant growth promotion and antagonistic properties of LAB in a comprehensive manner. We isolated LAB from various sources, including soil, plants, and fermented foods, and characterized their properties using biochemical and molecular techniques. We also evaluated their ability to promote the growth of different crop plants, such as rice, wheat, and maize, under different environmental conditions.

Furthermore, we investigated the antagonistic properties of LAB against a range of plant pathogens, including fungi and bacteria. We examined the mechanisms underlying the antifungal and antibacterial activities of LAB, such as the production of organic acids, hydrogen peroxide, and antimicrobial peptides.

Overall, our study provides valuable insights into the potential applications of LAB in agriculture and highlights the importance of exploring the multifaceted roles of microorganisms in plant-microbe interactions.

METHODS

The study was conducted using several strains of LAB, which were isolated from the rhizosphere of healthy plants. The plant growth promotion potential of LAB was assessed through various experiments, such as seed germination, root elongation, and plant biomass production. The antagonistic properties of LAB were evaluated by determining their ability to inhibit the growth of plant pathogens. The data collected were analyzed using statistical methods.

Isolation and identification of lactic acid bacteria:

Lactic acid bacteria were isolated from different plant sources using selective culture media and identified by standard biochemical and molecular techniques.

Evaluation of plant growth promotion:

The selected lactic acid bacteria were tested for their plant growth-promoting traits including phosphate solubilization, nitrogen fixation, and production of plant growth hormones like indole

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acetic acid (IAA), gibberellins (GA3), and cytokinins.

Evaluation of antagonistic properties:

The isolated lactic acid bacteria were screened for their antagonistic properties against common plant pathogens like Fusarium oxysporum, Rhizoctonia solani, and Phytophthora infestans. The antagonistic activity was evaluated by agar well diffusion assay and dual culture technique.

Optimization of plant growth promotion and antagonistic properties: The best-performing lactic acid bacteria were selected based on their plant growth promotion and antagonistic activity and further optimized for their efficacy. The optimization parameters included pH, temperature, and incubation time.

Field trials:

The selected lactic acid bacteria were tested in the field on different crops to evaluate their plant growth promotion and disease control efficacy under natural conditions.

Statistical analysis:

The data obtained from different experiments were statistically analyzed using ANOVA and Tukey's test to determine the significant differences between the treatments.

Characterization of the selected lactic acid bacteria: The selected lactic acid bacteria were characterized by sequencing their 16S rRNA gene and analyzing their phylogenetic relationship with other known lactic acid bacteria.

RESULTS

The results of this study revealed that LAB had significant plant growth promotion potential. The LAB strains were found to enhance seed germination, root elongation, and plant biomass production. The antagonistic properties of LAB were also demonstrated, as they were able to inhibit the growth of several plant pathogens. The statistical analysis showed that the plant growth promotion and antagonistic properties of LAB were strain-specific, indicating that different strains of LAB may have varying effects on plant growth and pathogen control.

DISCUSSION

The findings of this study highlight the potential of LAB as a promising tool for sustainable agriculture. LAB can provide an alternative approach to chemical fertilizers and pesticides, which can have negative impacts on the environment and human health. The strain-specific effects of LAB on plant growth promotion and pathogen control suggest that there is a need for further research to identify the most effective LAB strains for specific crops and environmental conditions.

CONCLUSION

In conclusion, this study provides evidence of the plant growth promotion and antagonistic

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properties of LAB. The results suggest that LAB could be used as a biofertilizer and biocontrol agent to promote sustainable agriculture. Further studies are needed to identify the most effective LAB strains and optimize their application in agriculture.

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