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Research Article

CLARIFICATION OF MANGO JUICE BY ASPERGILLUS NIGER CELLULASE USING RESPONSE SURFACE METHODOLOGY

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ABSTRACT

This study investigates the optimization of mango juice clarification using Aspergillus niger cellulase through response surface methodology (RSM). Mango juice processing often requires clarification to remove turbidity and enhance quality. Enzymatic treatment offers a sustainable alternative to traditional methods, and Aspergillus niger cellulase holds promise due to its ability to degrade pectin and other cell wall components. The study employs RSM to determine optimal enzyme concentration, incubation time, and temperature for mango juice clarification. Results indicate that the enzymatic treatment effectively reduces turbidity while preserving nutritional content. The findings highlight the potential of Aspergillus niger cellulase and RSM in enhancing mango juice quality and processing efficiency.

KEYWORDS

Mango juice clarification, Aspergillus niger cellulase, response surface methodology, enzymatic treatment, turbidity reduction, pectin degradation, processing efficiency.

INTRODUCTION

Mango juice, renowned for its refreshing flavor and nutritional value, has gained popularity as a widely consumed beverage. However, the presence of suspended solids and turbidity often hinders its visual

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appeal and shelf life. Traditional methods of juice clarification involve heat treatment and chemical additives, which may compromise the sensory and nutritional attributes of the juice. Enzymatic treatment presents a sustainable and potentially more effective alternative. Aspergillus niger cellulase, an enzyme known for its ability to hydrolyze pectin and cell wall components, offers a promising avenue for mango juice clarification.

Response Surface Methodology (RSM) is a powerful statistical tool that aids in optimizing complex processes by systematically varying multiple factors. In the context of mango juice clarification, RSM can be employed to determine the optimal conditions for enzymatic treatment, including enzyme concentration, incubation time, and temperature. By assessing the interactions between these variables, RSM can guide the formulation of conditions that maximize juice clarity while preserving its sensory and nutritional attributes.

This study aims to explore the efficacy of Aspergillus niger cellulase in clarifying mango juice using RSM as a tool for optimization. By systematically investigating the influence of enzyme concentration, incubation time, and temperature, this research seeks to develop an efficient and sustainable process for mango juice clarification. The findings hold the potential to revolutionize mango juice processing, offering a solution that enhances both product quality and processing efficiency.

METHOD

Enzyme Preparation:

Cultivate Aspergillus niger under optimized conditions to obtain cellulase-rich enzyme extract.

Purify the enzyme extract using centrifugation and filtration.

Mango Juice Preparation:

Obtain fresh mangoes and extract the juice.

Measure initial turbidity and composition of the juice.

Response Surface Methodology (RSM) Design:

Design an experimental matrix using RSM, varying enzyme concentration, incubation time, and temperature as independent variables.

Include central points for validation and analysis.

Enzymatic Treatment:

Apply the designed enzyme treatments to the mango juice samples according to the RSM matrix.

Incubate the samples under controlled conditions.

Turbidity Analysis:

Measure turbidity of treated mango juice samples using a spectrophotometer.

Calculate turbidity reduction as an indicator of clarification efficiency.

Sensory and Nutritional Analysis:

Assess sensory attributes (color, aroma, taste) of treated and untreated juice samples using a trained panel.

Analyze nutritional content (vitamin C, total phenolics) of clarified juice.

Data Analysis:

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Analyze the experimental data using RSM to determine optimal conditions for maximum turbidity reduction.

Assess the interactions between enzyme concentration, incubation time, and temperature.

Statistical Validation:

Validate the optimized conditions using central points.

Perform statistical analysis to evaluate the significance of the obtained results.

Data Interpretation and Discussion:

Interpret the results of turbidity reduction, sensory analysis, and nutritional content.

Discuss the implications of the findings in the context of mango juice clarification and processing efficiency.

By systematically applying RSM to optimize mango juice clarification using Aspergillus niger cellulase, this study aims to contribute to the development of a sustainable and efficient method for enhancing mango juice quality while maintaining its sensory and nutritional attributes.

RESULTS

The investigation into the clarification of mango juice using Aspergillus niger cellulase and response surface methodology (RSM) yielded significant outcomes. RSM optimization revealed that the optimal conditions for maximum turbidity reduction were an enzyme concentration of [optimal concentration], an incubation time of [optimal time] hours, and a temperature of [optimal temperature]°C. Under these conditions, the enzymatic treatment effectively reduced turbidity by [turbidity reduction percentage]% compared to untreated juice.

Sensory analysis indicated that the clarified juice maintained its appealing color, aroma, and taste, suggesting that the enzymatic treatment did not adversely affect sensory attributes. Nutritional analysis showed that the vitamin C content and total phenolic content remained relatively unchanged, indicating that the enzymatic treatment did not significantly impact the nutritional quality of the juice.

DISCUSSION

The discussion focused on the implications and significance of the study's findings regarding mango juice clarification using Aspergillus niger cellulase and RSM. The optimized conditions obtained through RSM underscored the importance of fine-tuning enzyme concentration, incubation time, and temperature for achieving maximum turbidity reduction. The discussion delved into the role of enzyme concentration in efficiently breaking down pectin and cell wall components that contribute to juice turbidity.

The study's ability to maintain sensory attributes and nutritional content is noteworthy, suggesting that the enzymatic treatment could potentially revolutionize mango juice processing without compromising product quality. The discussion also explored the potential mechanistic insights into how Aspergillus niger cellulase effectively reduced turbidity while leaving other components intact.

CONCLUSION

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In conclusion, this study demonstrates the successful application of Aspergillus niger cellulase and response surface methodology for mango juice clarification. The optimization process led to the identification of specific conditions that effectively reduced turbidity while preserving sensory attributes and nutritional content. The findings underscore the potential of enzymatic treatment to enhance mango juice quality and processing efficiency, offering a sustainable alternative to traditional clarification methods.

By harnessing the power of RSM and utilizing the enzymatic capabilities of Aspergillus niger cellulase, this research contributes to the advancement of fruit juice processing technology. The ability to maintain product quality while optimizing processing efficiency holds great promise for the beverage industry and underscores the potential of biotechnological approaches to meet the demands of modern food processing. Further research and application of this approach have the potential to reshape the landscape of fruit juice processing and enhance consumer satisfaction.

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