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Exploring Plant Tissue Culture for Enhanced Steviol Glycosides Production in *Stevia rebaudiana* Bertoni

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Abstract

Stevia rebaudiana (Bert.) Bertoni, commonly known as Stevia, is a plant of immense interest due to its natural sweetening properties attributed to steviol glycosides. As the demand for natural sweeteners rises, there is a growing interest in enhancing the production of steviol glycosides, such as stevioside and rebaudioside, in Stevia plants. Plant tissue culture techniques offer a promising avenue for mass propagation and manipulation of secondary metabolite production. This article explores the application of plant tissue culture methods for the enhancement of steviol glycosides production in *Stevia rebaudiana*.

Keywords: Plant • Tissue culture • Steviol glycosides

Introduction

Stevia rebaudiana, native to South America, has gained significant attention in recent years for its natural sweetening properties. The main sweet compounds present in Stevia leaves are steviol glycosides, primarily stevioside and rebaudioside. These compounds are several hundred times sweeter than sucrose and have garnered interest as low-calorie sweeteners due to their non-caloric nature. With the growing demand for natural, low-calorie sweeteners, there is a need to enhance the production of steviol glycosides in Stevia plants. Plant tissue culture techniques offer a promising approach to achieve this goal by providing a controlled environment for plant growth and manipulation of biochemical pathways [1].

Literature Review

Plant tissue culture involves the growth and manipulation of plant cells, tissues, or organs under controlled conditions. It offers several advantages over traditional methods of propagation, including rapid multiplication, production of disease-free plants, and the ability to manipulate secondary metabolite production. Key techniques utilized in plant tissue culture for *Stevia rebaudiana* include:

Micropropagation: Micropropagation involves the rapid multiplication of plantlets from small sections of explants, such as shoot tips or nodal segments. This technique allows for the production of a large number of uniform plants in a relatively short period, thus facilitating the scale-up of steviol glycosides production [2].

Callus culture involves the growth of undifferentiated cells derived from explants on a nutrient medium supplemented with plant growth regulators. Callus cultures can be induced to produce secondary metabolites, including steviol glycosides, by optimizing the composition of the growth medium and culture conditions.

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Cell suspension culture involves the growth of isolated plant cells in a liquid medium. Suspension cultures offer a homogeneous system for studying biochemical pathways and can be used for the production of high-value compounds, such as steviol glycosides, through metabolic engineering approaches [3].

Manipulation of environmental factors such as light intensity, temperature, and nutrient availability can influence the growth and secondary metabolite production in Stevia plants. By optimizing these parameters, it is possible to enhance the accumulation of steviol glycosides in plant tissues.

Discussion

Elicitation involves the application of biotic or abiotic stress factors to induce the production of secondary metabolites in plants. Various elicitors, such as methyl jasmonate, salicylic acid, and fungal elicitors, have been reported to enhance the production of steviol glycosides in *Stevia rebaudiana* cell cultures.

Genetic engineering techniques offer the possibility of enhancing steviol glycosides production in Stevia plants by manipulating key enzymes involved in their biosynthetic pathway. Transgenic approaches involving the overexpression or silencing of genes encoding enzymes such as UDP-glucosyltransferases and cytochrome P450s have shown promise in increasing steviol glycosides levels in Stevia plants [4].

Despite the potential of plant tissue culture techniques for enhancing steviol glycosides production in *Stevia rebaudiana*, several challenges remain. These include the optimization of culture conditions for maximum secondary metabolite accumulation, scaling up production to commercial levels, and addressing regulatory concerns related to genetically modified organisms (GMOs). Future research efforts should focus on addressing these challenges and exploring novel approaches, such as metabolic engineering and synthetic biology, to further enhance the production of steviol glycosides in Stevia plants [5,6].

Conclusion

Plant tissue culture techniques offer a promising avenue for enhancing the production of steviol glycosides in *Stevia rebaudiana*. By employing techniques such as micropropagation, callus culture, and cell suspension culture, along with strategies such as optimization of growth conditions, elicitation, and genetic transformation, it is possible to increase the yield of steviol glycosides for commercial applications. Continued research efforts aimed at overcoming existing challenges and exploring innovative approaches will contribute to the sustainable production of natural, low-calorie sweeteners from Stevia plants.

Acknowledgement

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Conflict of Interest

None.

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