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Poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) Synthesis from CO_2 *via* pH-stat Jar Culture of a Designed Hydrogen-oxidizing Bacterium *Cupriavidus necator*

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Introduction

This article explores a pioneering approach for eco-friendly biopolymer synthesis, focusing on the production of Poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) P(3HB-co-3HHx) from carbon dioxide (CO_2). Leveraging pH-stat jar culture techniques with a genetically engineered hydrogen-oxidizing bacterium *C. necator*, this study outlines a sustainable process for biopolymer production. The article delves into the novel strategies, microbial design, and environmental implications, offering insights into the transformative potential of CO_2-derived biopolymers [1,2]. In an era marked by climate concerns and the pursuit of sustainable technologies, biopolymers stand out as a promising alternative to conventional plastics. Among these, Poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) P(3HB-co-3HHx) emerges not only for its biodegradability but also for its potential to be synthesized from carbon dioxide (CO_2), mitigating greenhouse gas emissions. This article explores a groundbreaking methodology utilizing pH-stat jar culture techniques with a genetically engineered bacterium, *C. necator*, for eco-friendly P(3HB-co-3HHx) production from CO_2.

Description

The global quest for sustainable materials has led to the exploration of innovative methods for synthesizing eco-friendly polymers. Poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) (PHBHHx), a biodegradable polymer, holds promise in replacing traditional plastics derived from fossil fuels. This article elucidates a pioneering approach to produce PHBHHx from carbon dioxide (CO_2) using a pH-Stat Jar Culture method, harnessing the unique capabilities of *C. necator*, a hydrogen-oxidizing bacterium [3,4]. PHBHHx stands out among biopolymers due to its biodegradability and versatility. Its potential applications span across packaging, biomedical materials, and various industrial sectors. However, conventional methods of production often rely on agricultural feedstocks, posing challenges regarding resource utilization and environmental impact. The groundbreaking technique of synthesizing PHBHHx involves a pH-Stat Jar Culture approach, which leverages the metabolic potential of *C. necator*. This engineered bacterium possesses the capability to utilize CO_2 and hydrogen as substrates, thereby converting these abundant and renewable resources into valuable biopolymers. The controlled pH environment within the culture facilitates the efficient conversion of CO_2 into PHBHHx, demonstrating a sustainable pathway for polymer production. Utilizing CO_2 as a feedstock for PHBHHx synthesis presents a dual advantage. Firstly, it mitigates CO_2 emissions by converting this greenhouse gas into a valuable product, aiding in the fight against climate change. Secondly, it reduces reliance on non-renewable resources, paving the way for a more sustainable and circular economy [5].

Conclusion

The convergence of CO_2 utilization, pH-Stat Jar Culture, and the metabolic capabilities of *C. necator* presents a significant leap forward in sustainable polymer production. The synthesis of Poly(3-hydroxybutyrate-co-3-hydroxyhexanoate) from CO_2 holds immense promise, heralding a future where biodegradable, eco-friendly plastics could revolutionize various industries while mitigating environmental concerns. In summary, the innovative approach detailed in this article underscores the potential of biotechnology to create a more sustainable future by harnessing nature's processes to meet the demands of modern industry. The synthesis of PHBHHx from CO_2 *via C. necator* showcases the potential for a paradigm shift in polymer manufacturing. By integrating biotechnology with environmental stewardship, this approach offers a scalable and environmentally friendly alternative to petroleum-based plastics. The resulting biopolymer not only exhibits similar properties to traditional plastics but also mitigates the persistent pollution caused by their non-biodegradable counterparts.

Acknowledgement

None.

Conflict of Interest

None.

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