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A Quick Way to Lower Industrial Animal Cell Culture's Production of Ammonium and Lactic Acid

Nathaniel Crough*

Department of Food, Bioprocessing and Nutrition Sciences, North Carolina State University, Raleigh, NC 27695, USA

Abstract

The production of ammonium and lactic acid is a major challenge in industrial animal cell culture, affecting cell growth, productivity, and product quality. Ammonium and lactic acid are by-products of metabolism, specifically from the breakdown of amino acids and glucose, respectively. Their accumulation can lead to a decrease in culture pH, cell viability, and overall productivity. Therefore, strategies to lower the production of these metabolites are crucial for optimizing cell culture processes. This article explores quick and effective methods to reduce the production of ammonium and lactic acid in industrial animal cell culture.

Keywords: Ammonium • lactic acid • Animal cell

Introduction

Industrial animal cell culture is a vital process for producing biopharmaceuticals, but it can lead to the accumulation of harmful byproducts such as ammonium and lactic acid. These byproducts can negatively impact cell growth and product yield. In this article, we explore a quick and effective method to lower the production of ammonium and lactic acid in industrial animal cell culture, focusing on the use of media additives, process optimization, and alternative culture techniques. Animal cell culture is a crucial process in the production of biopharmaceuticals, vaccines, and cell-based therapies. However, the accumulation of byproducts such as ammonium and lactic acid can pose challenges to the efficiency and scalability of these processes. Ammonium is a product of cellular metabolism that can inhibit cell growth and reduce product yield, while lactic acid is a byproduct of anaerobic metabolism that can lead to acidification of the culture medium [1,2].

Literature Review

In this article, we discuss strategies to reduce the production of these byproducts in industrial animal cell culture. One approach to lower the production of ammonium and lactic acid in animal cell culture is to use media additives that can modulate cellular metabolism. For example, the addition of glutamine synthetase inhibitors such as methionine sulfoximine (MSX) can reduce the production of ammonium by inhibiting the enzyme responsible for converting glutamine to glutamate, a precursor of ammonium. Similarly, the addition of sodium bicarbonate or sodium hydroxide can help to neutralize lactic acid and prevent acidification of the culture medium. Optimizing the culture conditions can also help to reduce the production of ammonium and lactic acid. For example, optimizing the pH of the culture medium to be closer to the physiological range can reduce the accumulation of lactic acid. Similarly, optimizing the feeding strategy to provide nutrients in a more controlled manner can help to reduce the production of byproducts. Additionally, optimizing the cell density and agitation rate can help to improve oxygen transfer and reduce the accumulation of lactic acid [3,4].

***Address for Correspondence:** Nathaniel Crough, Department of Food, Bioprocessing and Nutrition Sciences, North Carolina State University, Raleigh, NC 27695, USA; E-mail: croughn@gmail.com*

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Discussion

Alternative culture techniques such as perfusion culture can also help to reduce the production of ammonium and lactic acid. Perfusion culture involves continuously removing a portion of the spent medium and replacing it with fresh medium, which can help to maintain a more stable pH and reduce the accumulation of byproducts. Similarly, using microcarrier-based culture systems can help to improve oxygen transfer and reduce the accumulation of lactic acid. Ammonium is produced primarily through the deamination of amino acids, particularly glutamine. In cell culture, glutamine is a key nutrient, but its metabolism leads to the formation of ammonium, which can inhibit cell growth and productivity. High levels of ammonium can cause cellular stress and toxicity, leading to reduced protein synthesis and cell death. Lactic acid is a by-product of anaerobic glucose metabolism via glycolysis. In high-density cultures, oxygen becomes a limiting factor, causing cells to shift to anaerobic metabolism even in the presence of oxygen (the Warburg effect). This results in the accumulation of lactic acid, which can lower the pH of the culture medium, affecting enzyme activity, cell viability, and product quality [5,6].

Conclusion

In conclusion, reducing the production of ammonium and lactic acid in industrial animal cell culture is essential for improving the efficiency and scalability of biopharmaceutical production. By using media additives, optimizing the culture process, and adopting alternative culture techniques, it is possible to lower the production of these harmful byproducts and improve the overall performance of animal cell culture systems. Reducing the production of ammonium and lactic acid in industrial animal cell culture is essential for improving the efficiency and quality of biomanufacturing processes. By optimizing nutrient concentrations, employing metabolic engineering, using alternative carbon sources, enhancing oxygen supply, and refining bioreactor design, it is possible to significantly lower the levels of these undesirable metabolites. Future advancements in technology and a deeper understanding of cell metabolism will further enhance our ability to control and optimize cell culture conditions, paving the way for more sustainable and productive bioprocessing.

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Conflict of Interest

There is no conflict of interest by author.

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