Chapter 12
Advancements in Bioprocess Engineering and Plasma: Revolutionizing Medicine Production

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ABSTRACT

Bioprocess engineering and plasma technology have ushered in a new era of medicine production, transforming the pharmaceutical industry, and improving healthcare outcomes. This chapter explores the latest advancements in these fields and their significant impact on revolutionizing medicine production. The authors delve into key developments in bioprocess engineering, such as genome editing techniques, high-throughput screening, continuous bioprocessing, and synthetic biology. Additionally, the authors examine the diverse applications of plasma technology, including sterilization, plasma-enhanced chemical vapour deposition, disinfection of biological fluids, and plasma activation of surfaces. Together, these innovative approaches have accelerated drug development, enhanced drug delivery systems, and paved the way for personalized medicine.

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1. INTRODUCTION

The landscape of medicine production has undergone a remarkable transformation in recent years, driven by advancements in bioprocess engineering and plasma technology (Lee & Kim, 2015; Jinek et al., 2012). These cutting-edge disciplines have revolutionized the pharmaceutical industry, enabling the efficient and cost-effective production of complex therapeutic compounds (Pörtner, 2005). In this chapter, we will provide an overview of the key developments in bioprocess engineering and plasma technology that have led to this revolution in medicine production (Kamei et al., 2014; Traylor et al., 2012). Additionally, we will explore the impact of these advancements on healthcare outcomes, paving the way for more personalized and effective treatments (Lin et al., 2016; Wang et al., 2017). The chapter will conclude with a glimpse into the future of these fields and their potential implications for the pharmaceutical industry and patients worldwide (Giesselmann et al., 2018; Lee et al., 2018).

1.1 Background

The process of producing pharmaceuticals has historically relied on chemical synthesis and extraction from natural sources. While these methods have served the industry well, they often present challenges in terms of cost, scalability, and the ability to produce complex molecules (Lee et al., 2004). Bioprocess engineering emerged as a novel approach to address these issues by leveraging living organisms' capabilities to synthesize valuable products. Through genetic modification and advanced biotechnological techniques, researchers have harnessed microorganisms and cells to produce high-value pharmaceutical compounds, such as therapeutic proteins and antibodies (Ito & Inoue, 2012; Lee et al., 2004).

Concurrently, plasma technology, the ionized gas state, has gained momentum in various industries, including medicine production. Plasma's unique properties, such as its ability to disinfect and modify surfaces, have found extensive applications in the healthcare sector (Machala et al., 2012; Vandamme et al., 2010). From sterilizing medical equipment to enhancing drug delivery systems, plasma technology has significantly improved the safety and efficacy of pharmaceutical products (Kawano et al., 2014; Notte, 2005).

1.2 Aim and Scope

The primary aim of this chapter is to provide a comprehensive overview of the recent advancements in bioprocess engineering and plasma technology and their impact on medicine production (Pasquel-Reátegui et al., 2018; Yamada & Foote, 1968). By reviewing the latest research and studies, we will highlight the key breakthroughs in these fields and their potential to revolutionize the pharmaceutical industry (Hamdan et al., 2016; Zhong et al., 2014).

Throughout this chapter, we will incorporate references from reputable scientific journals, conference proceedings, and books to substantiate the discussed advancements and provide readers with a well-rounded understanding of the subject matter (Bagheri et al., 2017; Brandenburg et al., 2015). The scope of this chapter will cover various aspects of bioprocess engineering and plasma technology, including genome editing techniques, high-throughput screening, continuous bioprocessing, synthetic biology applications, plasma sterilization, plasma-enhanced chemical vapor deposition, plasma disinfection of biological fluids, and plasma activation of surfaces (Kuznetsov et al., 2019; Varjo et al., 2015).