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Advances in Viral Antigen Production for Vaccines Post-pandemic Using Prokaryotic and Eukaryotic Expression Systems

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Introduction

The development of vaccines has been a cornerstone of global public health, especially in the wake of the COVID-19 pandemic. The rapid emergence of the pandemic underscored the need for efficient vaccine production systems capable of producing high-quality antigens quickly. This need has spurred significant advances in viral antigen production, particularly using prokaryotic and eukaryotic expression systems. Both systems have their strengths and limitations, but innovations in both have led to improved methods for producing viral antigens that are critical for vaccine development. This article will explore the developments in post-pandemic viral antigen production for vaccines, focusing on prokaryote and eukaryote-based expression systems. Vaccines are designed to stimulate an immune response that prepares the body to fight off specific pathogens, such as viruses. One of the critical components of vaccine development is the production of antigens — molecules that trigger an immune response. Viral antigens are typically derived from virus proteins, and their production must be precise to ensure safety and effectiveness. The challenge lies in producing these antigens efficiently and at scale. The systems used to express and purify these antigens are crucial in determining the quality and quantity of the vaccine. Two primary expression systems are commonly used for viral antigen production: prokaryotic (bacterial) systems and eukaryotic (mammalian, insect, or yeast) systems [1,2].

Description

Prokaryotic expression systems, particularly *Escherichia coli (E. coli)*, have long been utilized in the production of recombinant proteins, including viral antigens. One of the major advantages of using prokaryotic systems is their rapid growth and the ease with which they can be genetically engineered. Additionally, they are often cost-effective and allow for high-yield production. This makes them an attractive choice for producing antigens on a large scale. The COVID-19 pandemic has accelerated the development of new vaccine technologies. Viral antigen production systems, including both prokaryotic and eukaryotic expression systems, have been crucial in the rapid development of vaccines. For example, the mRNA vaccines for COVID-19 utilized viral spike protein antigens, which were produced using eukaryotic expression systems in mammalian cells or insect cells. Additionally, the rapid advancements in viral vector vaccines, such as adenoviral vectors, have relied heavily on these expression systems to generate the viral proteins required for immune stimulation. These innovations have set the stage for more rapid responses to future pandemics [3-5].

Conclusion

In the post-pandemic era, advancements in viral antigen production have enabled the faster development of vaccines, crucial for global health security. Both prokaryotic and eukaryotic expression systems play a vital role in this process, each offering distinct advantages depending on the nature of the viral antigen being produced. Prokaryotic systems provide cost-effective and rapid production, while eukaryotic systems are necessary for producing more complex proteins that require post-translational modifications. Ongoing innovations continue to refine these systems, improving their efficiency, scalability, and cost-effectiveness. As we move forward, hybrid systems and new technologies will likely further enhance the ability to produce viral antigens and vaccines more quickly and efficiently, ensuring preparedness for future global health challenges.

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Conflict of Interest

None.

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