Clinical Pharmacology & Biopharmaceutics

Mini Review Open Access

Advancements in Oral Delivery of Biopharmaceuticals: Harnessing Plant-Based Platforms

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Abstract

The oral delivery of biopharmaceuticals represents a revolutionary approach to enhance patient adherence and therapeutic efficacy. Recent advancements in plant-based platforms have emerged as promising strategies for the oral delivery of biopharmaceuticals, offering scalability, cost-effectiveness, and safety. This abstract provides an overview of the latest advancements in plant-based platforms for oral delivery of biopharmaceuticals, highlighting their potential to revolutionize drug delivery and improve Cost patient outcomes.

Keywords: Biopharmaceuticals; Therapeutic efficacy; Cost effectiveness

Introduction

The oral delivery of biopharmaceuticals presents a transformative approach to enhance patient compliance, convenience, and therapeutic efficacy. While traditional delivery routes for biopharmaceuticals often involve injections, oral delivery offers non-invasive administration and improved patient acceptance. In recent years, plant-based platforms have emerged as promising vehicles for oral delivery of biopharmaceuticals, leveraging the inherent advantages of plant systems, such as scalability, cost-effectiveness, and safety. This article explores the latest advancements in plant-based platforms for oral delivery of biopharmaceuticals, highlighting their potential to revolutionize drug delivery and patient care.

Plant-based platforms for oral delivery

Plants offer a versatile platform for the production and delivery of therapeutic proteins, peptides, and vaccines. Various plant species, including tobacco, maize, rice, and lettuce, have been genetically engineered to produce recombinant proteins of interest, which can be orally administered to deliver biopharmaceuticals. Plant-based expression systems, such as transient expression in leaves or stable transformation of seeds, enable efficient production and accumulation of therapeutic proteins in plant tissues [1,2].

Advantages of plant-based oral delivery

Plant-based platforms offer several advantages for oral delivery of biopharmaceuticals. Firstly, plants provide a cost-effective and scalable production system, allowing for large-scale cultivation and downstream processing of therapeutic proteins [3]. Additionally, plant-derived biopharmaceuticals are inherently safe, free from human pathogens or animal-derived contaminants, reducing the risk of adverse reactions and immunogenicity. Moreover, oral delivery of plant-produced biopharmaceuticals bypasses the need for injections, improving patient compliance and reducing healthcare costs associated with administration [4].

Engineering plant systems for enhanced oral delivery

Advancements in genetic engineering and plant biotechnology have enabled the development of tailored plant systems optimized for oral delivery of biopharmaceuticals. Strategies such as fusion with carrier proteins, inclusion of targeting peptides, and modulation of glycosylation patterns can enhance the stability, bioavailability, and tissue-specific targeting of plant-produced biopharmaceuticals [5]. Furthermore, the incorporation of encapsulation technologies, such as plant-derived exosomes or virus-like particles, can protect biopharmaceuticals from enzymatic degradation and facilitate their transport across the intestinal epithelium [6,7].

Case studies and clinical applications

Several plant-derived biopharmaceuticals have demonstrated promising results in preclinical studies and clinical trials for oral delivery. For example, plant-produced vaccines against infectious diseases, such as hepatitis B and norovirus, have shown immunogenicity and protective efficacy in animal models and human subjects. Likewise, oral delivery of therapeutic proteins, such as insulin and erythropoietin, has been explored using plant-based platforms, with encouraging results in terms of pharmacokinetics and bioactivity [8].

Challenges and future directions

Despite the progress made in plant-based oral delivery of biopharmaceuticals, several challenges remain to be addressed. These include optimization of expression levels, post-translational modifications, and scalability of production [9]. Moreover, regulatory considerations, intellectual property issues, and public acceptance may influence the translation of plant-derived biopharmaceuticals into clinical practice. Future research efforts should focus on addressing these challenges and advancing plant-based platforms for oral delivery to realize their full potential in healthcare [10].

Conclusion

Plant-based platforms hold immense promise for the oral delivery of biopharmaceuticals, offering a sustainable, cost-effective, and patient-friendly approach to drug delivery. By harnessing the power of plant biotechnology and genetic engineering, researchers can overcome the challenges associated with oral delivery and unlock

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Received: 01-Apr-2024, Manuscript No: cpb-24-133361; **Editor assigned:** 02-Apr-2024, Pre-QC No: cpb-24-133361(PQ); **Reviewed:** 22-Apr-2024, QC No: cpb-24-133361; **Revised:** 24-Apr-2024, Manuscript No: cpb-24-133361(R); **Published:** 29-Apr-2024, DOI: 10.4172/2167-065X.1000445

Citation: Joyce B (2024) Advancements in Oral Delivery of Biopharmaceuticals: Harnessing Plant-Based Platforms. Clin Pharmacol Biopharm, 13: 445.

the full therapeutic potential of biopharmaceuticals for improved patient care and public health. As advancements in plant-based oral delivery continue to unfold, the future of biopharmaceuticals appears increasingly promising, paving the way for transformative innovations in drug delivery and disease management.

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