Precision delivery of biomolecules: Particle bombardment for RNA and protein uptake.

Rajkuberan Prayaj*

Department of Biotechnology, Plant Pathology Research Institute, Agricultural Research Center, Giza, Egypt

Introduction

In the ever-evolving landscape of biotechnology, achieving precise and targeted delivery of biomolecules into cells is a crucial aspect of unlocking new possibilities for research and application. One technique that has gained prominence for its ability to achieve this feat is particle bombardment, also known as biolistic or gene gun delivery. This innovative approach enables the direct introduction of various biomolecules, including RNA and proteins, into a wide range of cells with remarkable precision. In this article, we explore the concept of particle bombardment, its mechanisms, and its transformative potential in facilitating RNA and protein uptake for diverse biotechnological applications.

Particle bombardment is a physical method used to deliver biomolecules into cells by propelling micro- or nanoparticles coated with the desired cargo at high velocities. This approach overcomes the challenge of cellular barriers, such as cell walls or membranes that can hinder the direct entry of biomolecules. Instead of relying on endocytosis or other passive mechanisms, particle bombardment uses kinetic energy to facilitate the transfer of biomolecules into cells, resulting in more efficient and targeted delivery.One of the most significant advantages of particle bombardment is its ability to deliver a wide range of biomolecules, including RNA and proteins, directly into the cell cytoplasm or nucleus. This feature is especially valuable when precision and accuracy are essential, such as in gene therapy, functional genomics, and therapeutic protein production [1].

For RNA delivery, particle bombardment offers an advantage over traditional transfection methods. Unlike chemical transfection reagents, which may affect cell viability or induce unwanted immune responses, particle bombardment minimizes these concerns. Moreover, it allows the introduction of large RNA molecules, such as messenger RNA (mRNA) that may be prone to degradation or inefficient uptake through other means.

Similarly, protein delivery via particle bombardment offers a promising alternative to traditional protein expression systems. Rather than relying on cell-based expression or purification, researchers can directly introduce proteins of interest into cells, reducing the complexity of the process and potentially improving the efficiency of protein uptake and functionality [2].

The success of particle bombardment hinges on the principles of kinetics and mechanical force. The process involves loading micro- or nanoparticles with the desired biomolecules, such as RNA or proteins. These particles are then accelerated to high velocities using a device known as a gene gun or biolistic delivery system. The particles are propelled into a target cell population, where the kinetic energy of impact facilitates the transfer of biomolecules into the cells. The process is gentle enough to avoid causing significant cellular damage while being forceful enough to overcome cellular barriers. Particle bombardment's precision and versatility make it a valuable tool in a range of biotechnological applications. In gene therapy, for instance, particle bombardment can deliver therapeutic RNA molecules directly into target cells, potentially correcting genetic defects or modulating cellular processes. The method also shows promise in cancer research, where it can be employed to deliver therapeutic proteins that directly affect tumor cells while sparing healthy tissues.

Functional genomics research benefits from particle bombardment's ability to introduce specific RNA molecules into cells for gene silencing or overexpression studies. This technique enables researchers to dissect the roles of individual genes and unravel complex biological pathways with precision.In the field of agriculture, particle bombardment has opened avenues for crop improvement. Researchers can introduce genes encoding desired traits into plant cells to develop genetically modified crops with enhanced yield, stress tolerance, or nutritional content [3,4].

As with any technology, particle bombardment comes with its own set of challenges and areas for improvement. One such challenge is optimizing the efficiency of biomolecule delivery, as not all cells within a target population may be successfully transfected. Researchers are continually refining parameters such as particle size, velocity, and biomolecule loading to enhance delivery rates. In the future, integrating particle bombardment with other techniques, such as genome editing tools like CRISPR/Cas9, could offer even greater precision in modifying cellular genomes. Additionally, advancements in nanoparticle design and surface modifications may further enhance the specificity and efficiency of particle bombardment-based delivery [5].

***Correspondence to:** Rajkuberan Prayaj, Department of Biotechnology, Plant Pathology Research Institute, Agricultural Research Center ,Giza, Egypt, Email id**:** rajkuberanprayaj@hotmail.com.

***Received:** 08-Jul -2023, Manuscript No. AAAIB-23-112115; **Editor assigned:** 11- Jul -2023, PreQC No. AAAIB-23-112115 (PQ); **Reviewed:** 25- Jul -2023, QC No. AAAIB-23-112115; **Revised:** 28-Jul-2023, Manuscript No. AAAIB-23-112115 (R); **Published:** 04-Aug-2023, DOI:10.35841/aaaib-7.4.157*

***Citation:** Prayaj R. Precision delivery of biomolecules: Particle bombardment for RNA and protein uptake. 2023;7(4):157*

Conclusion

Particle bombardment has emerged as a powerful and precise method for delivering RNA and proteins into cells. Its ability to bypass cellular barriers and directly introduce biomolecules of interest offers unprecedented control and versatility in biotechnological applications. Whether applied in gene therapy, functional genomics, cancer research, or crop improvement, particle bombardment continues to push the boundaries of what is possible in precision biomolecule delivery. As research and technology continue to evolve, particle bombardment holds the potential to revolutionize various fields by enabling the targeted uptake of biomolecules and unlocking new frontiers in biotechnology.

References

1. Luo D, Saltzman WM. Synthetic DNA delivery systems. Nat Biotechnol. 2000;18(1):33-7.
2. Kanaras AG, Kamounah FS, Schaumburg K, et al. Thioalkylated tetraethylene glycol: a new ligand for water soluble monolayer protected gold clusters. Chem Commun (Camb)2002;(20):2294-5.
3. Izumi CM, Andrade GF, Temperini ML. Surface-enhanced resonance Raman scattering of polyaniline on silver and gold colloids. J Phys Chem B.2008;112(51):16334-40
4. Canter PH, Thomas H, Ernst E. Bringing medicinal plants into cultivation: opportunities and challenges for biotechnology. Trends Biotechnol. 2005;23(4):180-5.
5. Zhang H, Cao Y, Xu D, et al. Gold-nanocluster-mediated delivery of siRNA to intact plant cells for efficient gene knockdown. Nano letters. 2021;21(13):5859-66.

Citation: *Prayaj R. Precision delivery of biomolecules: Particle bombardment for RNA and protein uptake. 2023;7(4):157*