

Mitochondrial encapsulation technology for mitochondrial transplantation therapy

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Keywords: mitochondria transplantation, metal-organic frameworks, biomineralization

INTRODUCTION

Mitochondria is an organelle that performs significant functions within cells, including biosynthesis, cell death, cell metabolism, etc. Dysfunctions in mitochondria are associated with an increasingly enormous number of diseases and disorders, such as cardiovascular diseases, metabolic syndrome, and cancer. Mitochondria is, therefore, a significant therapeutic target for various diseases and conditions.

- Short-lived bioactivity (<6 hours).
- Hard to encapsulate entire and bioactive mitochondria.
- Difficult to deliver mitochondria through biological barriers / other cells.
- Challenges in storage and transportation.
- Huge business potential but lacks novel technology to support the utilization of mitochondria.

Mitochondrial transplantation attempting is seen as a new innovative strategy for treating mitochondrial dysfunction, and increasingly preclinical and clinical studies are working on it. However, isolated mitochondria are easily disturbed by the external environment, which will affect their bioactive. Usually, the life span of isolated mitochondria is shorter than six hours. Also, the negativity of mitochondria makes it difficult for cells to internalize. Therefore, developing a new technique to solve the bottleneck of clinical application of mitochondrial transplantation is necessary.

METHODS

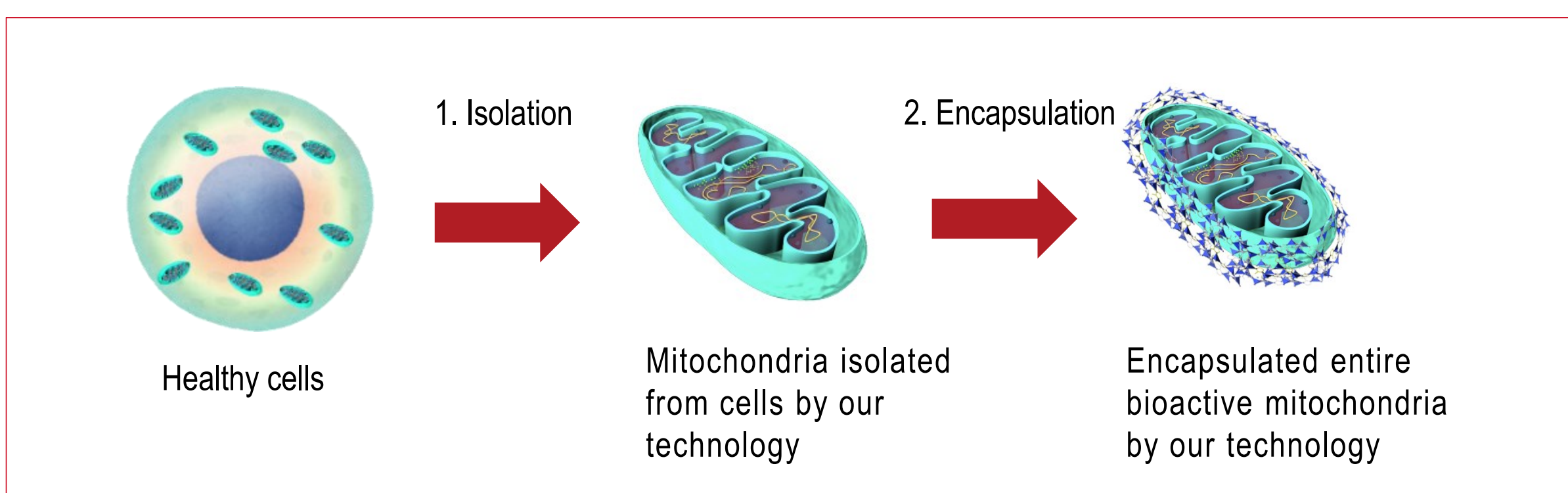


Figure 1: Scheme of our technology

Our approach for the coating technique is based on the biomineralization of mitochondria in Metal-Organic Frameworks (MOF's). The MOF layer allows us to have adjustable molecular level pores, which prevent the macromolecular-like enzymes from entering, but allows the small molecules, such as water and oxygen to pass. Therefore, this unique coating technology can not only protect the mitochondria but also does not stop the nutrition supply to guarantee the long-lasting maintenance of mitochondria bioactivity.

PROOF-OF-CONCEPT

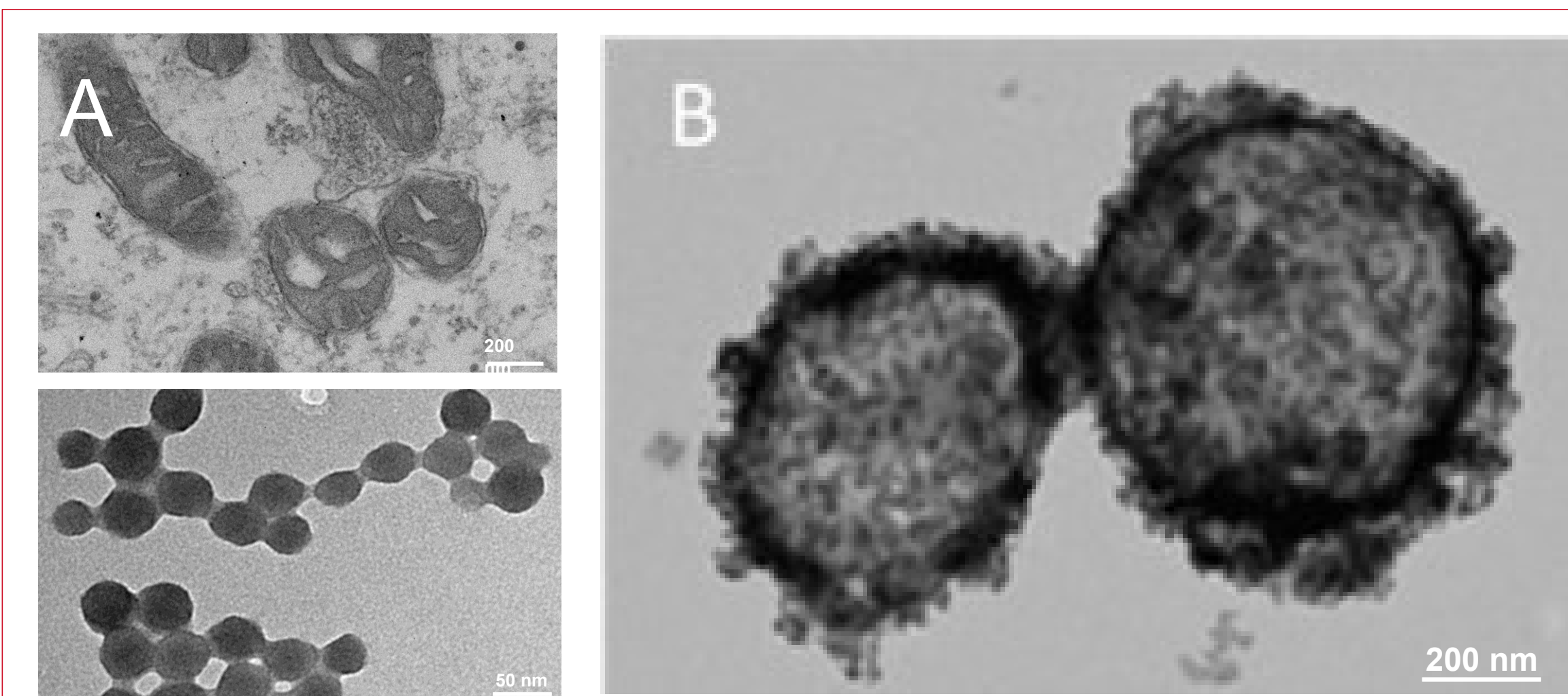


Figure 2: A) TEM of isolated mitochondria and blank nanoparticles with polyhedral structure; B) Encapsulated mitochondria, MoF's layer form a cage-like structure to protect mitochondria.

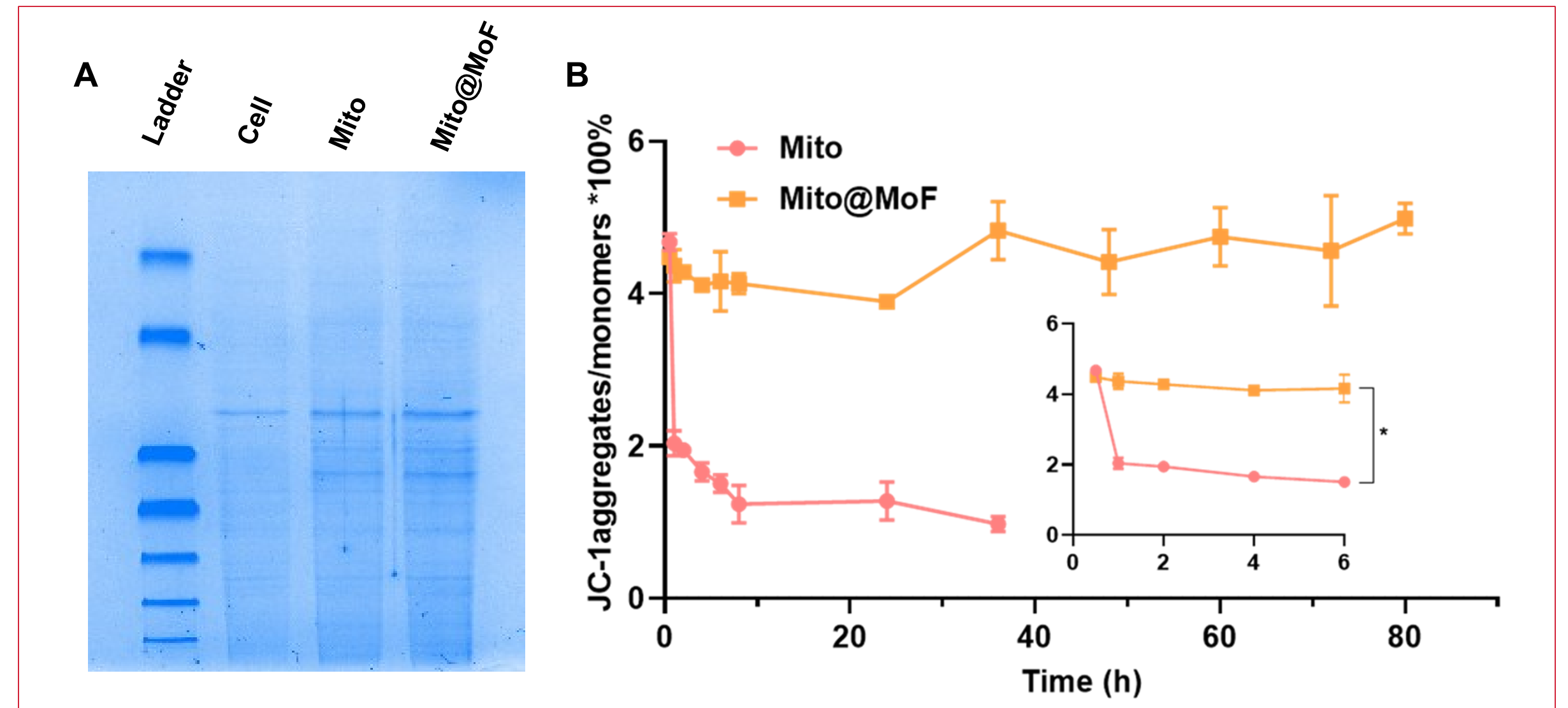


Figure 3: A) Coomassie result showed that MoF's encapsulated mitochondria themselves; B) JC-1 result demonstrated MoF's can stabilize the mitochondrial membrane potential.

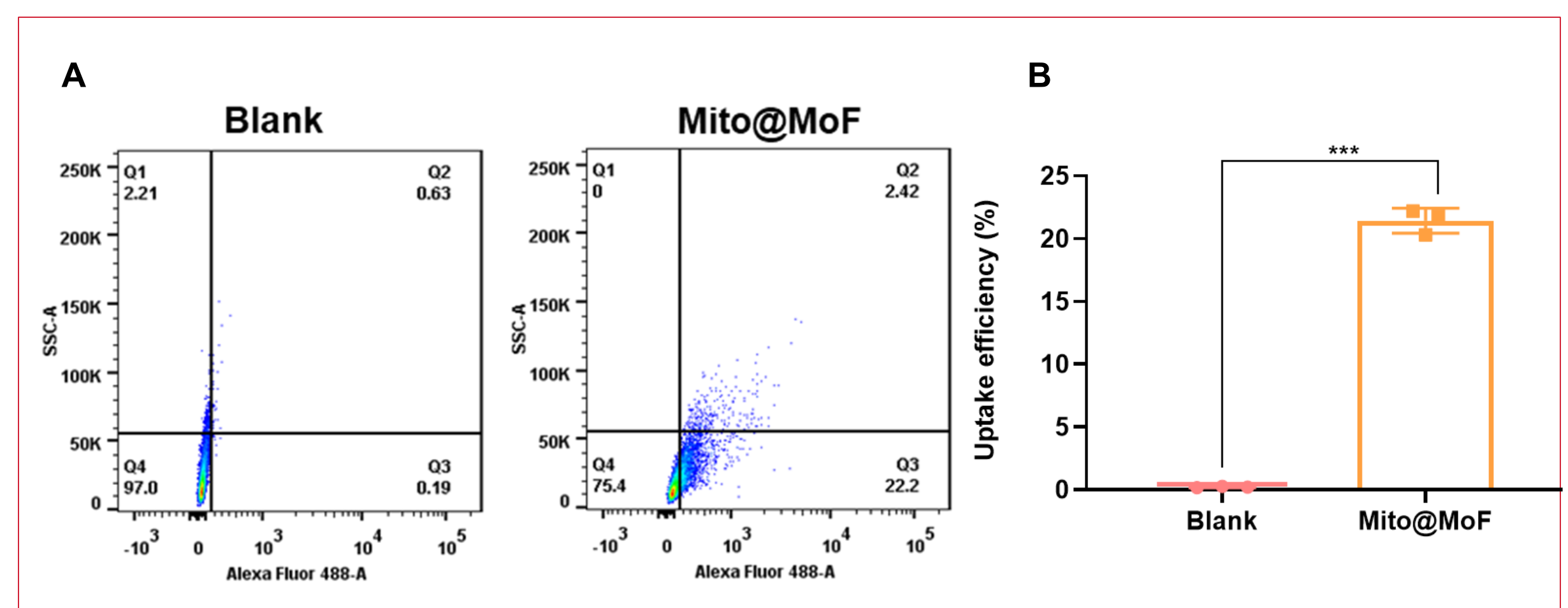


Figure 4: A) Cells can further endocytosis the MoF's encapsulated mitochondria; B) and efficiency with a statistic difference

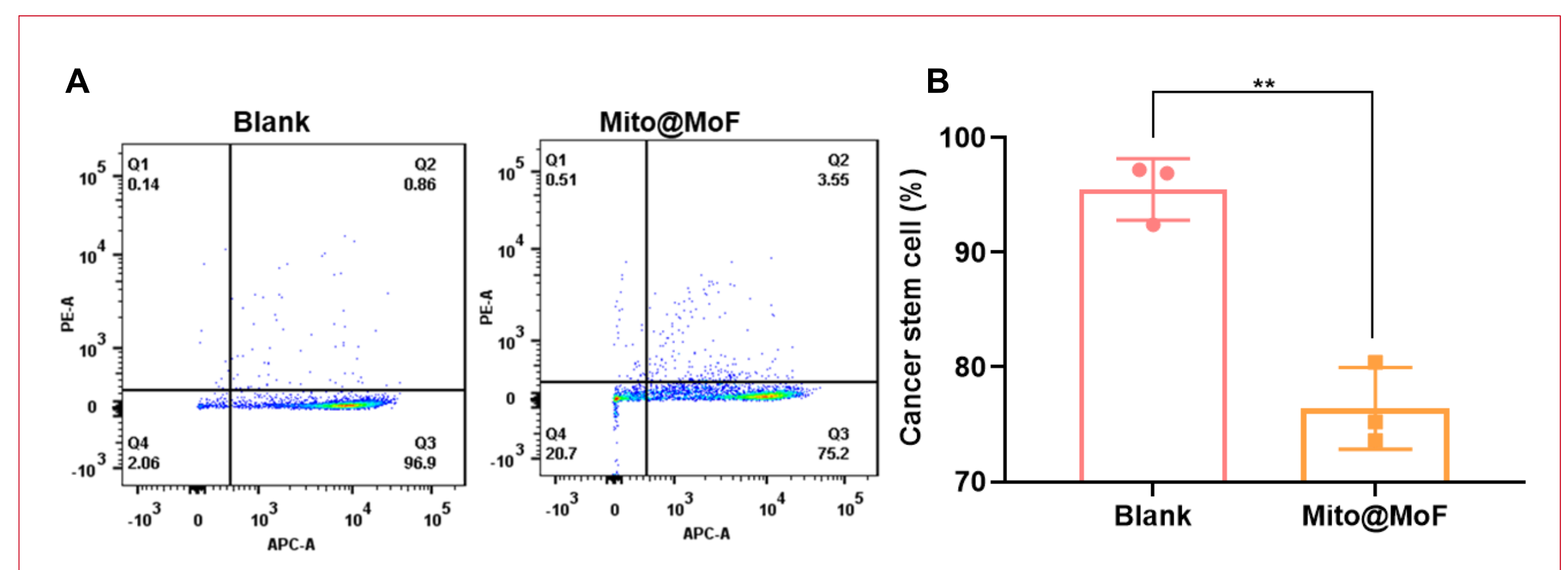


Figure 5: MoF's encapsulated mitochondria can further inhibit the population of cancer stem-like cells

CONCLUSIONS

Our team has developed the biomineralization technology/method for mitochondria called Comitell®. The MOF layer protects the mitochondria within but has adjustable molecular level pores preventing the macromolecular-like enzymes from entering and allowing smaller molecules to pass. Therefore, this unique coating technology can guarantee the long-lasting maintenance of mitochondria bioactivity and provides more flexible uses in clinical trials.

Our mission is to bring our innovative solutions to the market by conducting ground-breaking research and forming strategic partnerships with academic institutions, and the pharmaceutical industry. We are committed to develop innovative mito trans solutions that are safe, effective, and accessible to patients worldwide. By harnessing the power of mitochondria, we can reach new treatments for conditions ranging from metabolic disorders, neurodegenerative diseases, and other mitochondria-related diseases.

ACKNOWLEDGEMENTS

