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An Essential Method for Biomedical Research: Cell Culture

Sara Meire*

Department of Cell Culture and Bioprocess Engineering, University College Dublin, Dublin, Ireland

Introduction

A key method in biomedical research for studying and modifying cells in a controlled setting is cell culture. It entails the separation, growth and upkeep of cells away from their native habitat, giving researchers a potent instrument to examine cellular activity, discover the causes of disease and create novel treatments. Cell culture has transformed a number of disciplines over time, including biotechnology, regenerative medicine, drug development and cancer research. We shall examine the complexities of cell culture, including its methods, uses, difficulties and potential in the future, in this extensive essay. Numerous cell types, such as stem cells, immortalized cell lines and primary cells that are directly generated from tissues, can be used in cell culture. Every cell type in culture has distinct traits, benefits and difficulties of its own [1].

Adherent culture and suspension culture are the two primary methods of cell culture. Suspension culture permits cells to grow freely in a liquid media, whereas adherent culture comprises cells that need to adhere to a substrate in order to proliferate. For cells to survive and proliferate, they need a specific growth medium that supplies the nutrients, growth factors hormones they need. To support particular cell types or experimental conditions, these media can be enhanced with serum, growth hormones, antibiotics and other chemicals. Cells are separated from their tissue or organ source during the cell isolation process, typically by mechanical disruption or enzymatic digestion. To generate a pure and viable cell population, this step is essential. To maintain the cells' viability and enable long-term studies, sub culturing or passaging is performed. This involves the detachment of cells from the culture vessel, followed by their reseeding into fresh culture dishes. Cryopreservation allows for the long-term storage of cells by freezing them at ultra-low temperatures using cry protective agents. This technique is crucial for preserving valuable cell lines, primary cells and stem cells, allowing researchers to establish cell banks and share resources [2].

Description

Because it makes it possible to investigate tumor biology, medication screening and customized treatment, cell culture is essential to cancer research. It is possible to study the course of cancer, the mechanisms underlying medication resistance and possible therapeutic targets by cultivating tumor cell lines obtained from patient samples. In the early phases of drug development, cell culture models are often utilized as an ethical and economical substitute for animal models. Researchers can find promising lead compounds for additional development by high-throughput screening of chemical libraries against cultured cells. Techniques for tissue engineering and stem cell culture have created new opportunities in regenerative medicine. Scientists can create tissues and organs for transplantation, research disease models and create novel treatments by cultivating and differentiating stem cells into particular cell lineages. Cell culture provides a controlled environment to study the replication, pathogenesis and immune response of various viral, bacterial and parasitic infections. It enables the development of vaccines, antiviral drugs and diagnostic tools to combat infectious diseases [3].

Cell culture is extensively used in the production of biopharmaceuticals, including recombinant proteins, monoclonal antibodies and vaccines. Large-scale cell culture techniques such as bioreactors are employed to meet the demands of the biotechnology and pharmaceutical industries. Maintaining a sterile culture environment is crucial to prevent contamination by bacteria, fungi, mycoplasma and other microorganisms. Contamination can lead to altered cell behavior, experimental inconsistencies and compromised research outcomes. Continuous passaging of cells can lead to genetic changes, such as mutations, chromosomal rearrangements, or altered gene expression profiles. Additionally, cross-contamination between different cell lines can occur, leading to misinterpretation of experimental results. Cells in culture can undergo phenotypic changes, losing their original characteristics and acquiring new properties. This phenomenon, known as cell line drift, can impact the reproducibility and reliability of research findings [4].

The advent of gene editing technologies, particularly CRISPR-Cas9, has revolutionized cell culture research. These techniques enable precise genetic modifications, such as gene knockouts, knock-ins and gene corrections and allowing researchers to unravel gene function and study disease mechanisms. Organ-on-a-chip platforms integrate microfluidics, cell culture and tissue engineering to create miniature organ models that recapitulate the structure and function of specific organs. These models have the potential to revolutionize drug testing, personalized medicine and toxicology studies [5].

Conclusion

In biomedical research, cell culture is an essential approach that allows researchers to study the complexities of cell biology, look into the causes of disease and create novel treatments. Even though preserving cell lines, contamination and genetic drift are problems, cell culture is still developing and using new technology and methods to improve experimental results. Cell culture will surely be essential in determining the direction of biotechnology and medicine in the future as our knowledge of tissue engineering and cell behavior grows.

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Conflict of Interest

None.

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***Address for Correspondence:** Sara Meire, Department of Cell Culture and Bioprocess Engineering, University College Dublin, Dublin, Ireland, E-mail: meire96@be.ir*

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