

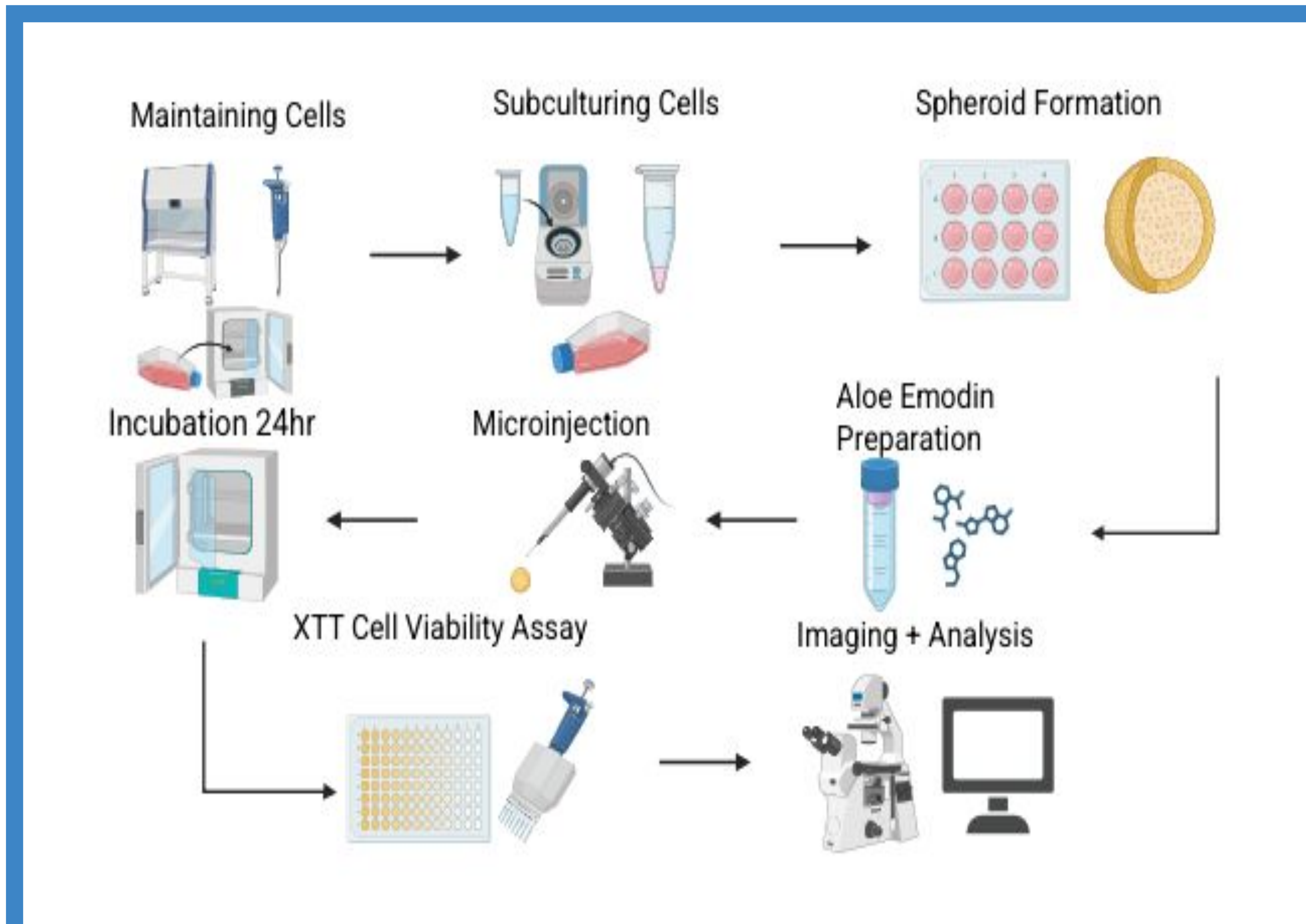
## Introduction & Objectives

Breast cancer remains a major cause of death worldwide, and current treatments can be highly invasive and damaging to healthy cells. This project aims to explore aloe-emodin, a compound found in Aloe vera, as a potential gentler alternative. Aloe-emodin has antioxidant and anti-inflammatory properties that may affect cancer cell growth.

The objective of this study is to examine how aloe-emodin impacts MCF-7 breast cancer spheroids when delivered directly into the cell mass through microinjection. By comparing treated spheroids to untreated and vehicle controls, this research will evaluate changes in cell viability and morphology. The goal is to determine whether aloe-emodin shows potential as a complementary, less harmful approach to breast cancer treatment.

## Quantitative Analysis of Aloe-Emodin-Induced Cytotoxicity in MCF-7 Breast Cancer Spheroids Using Microinjection Delivery and Metabolic Activity Assessment via XTT Assay and ImageJ Morphometric Evaluation

### Procedures



Created in <https://BioRender.com>

## Expected Outcomes

It is expected that aloe-emodin will decrease the viability of MCF-7 breast cancer spheroids when delivered directly into the spheroid core through microinjection. Treated spheroids are anticipated to show reduced metabolic activity, darker or irregular regions, and possible early signs of apoptosis compared to untreated and vehicle-injected controls. Because the treatment is localized, changes are expected to be concentrated near the injection site rather than uniformly across the entire spheroid. Overall, aloe-emodin is predicted to demonstrate measurable cytotoxic effects, supporting its potential as a complementary and less harmful therapeutic option for breast cancer.

## Assumptions & Limitations

This study assumes sterile BSL-2 conditions, properly maintained MCF-7 spheroids, accurate aloe-emodin preparation, and consistent microinjection volumes across samples. It also assumes that spheroids respond uniformly and that imaging and XTT measurements accurately reflect cell health.

Limitations include potential variation in spheroid size, microinjection inconsistency, and aloe-emodin diffusion differences within each spheroid. Results may not apply to other breast cancer cell lines or 2D cultures. The study also uses a single time point and one viability assay, which may not capture all cellular responses. Additionally, the chosen concentrations and delivery method may not represent aloe-emodin's full therapeutic potential.

## Implications

Scientifically, this study contributes to research on natural compounds by examining how aloe-emodin affects breast cancer cells when delivered directly into 3D spheroids. It adds insight into targeted drug delivery and how localized treatment influences cell health and structure. Medically, aloe-emodin could one day serve as a complementary therapy that causes less damage to healthy tissue than traditional treatments. Societally, exploring plant-derived compounds may provide more accessible and less invasive options for communities with limited resources. Economically, aloe-emodin offers the possibility of a lower-cost therapeutic lead and may encourage further development of natural compounds in pharmaceutical research. Future studies should investigate long-term safety, effects on additional cancer types, and how aloe-emodin might work alongside existing therapies.