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DEVELOPMENT OF EDIBLE SCAFFOLDS FOR CELL-BASED FOOD

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I. INTRODUCTION

Cell-based food, grown from animal cells in a lab, offers solutions to environmental issues caused by traditional livestock farming. Various companies, both foreign and domestic, are developing this technology. Challenges include finding alternatives to fetal bovine serum and improving 3D culturing methods, particularly in developing suitable scaffolds [1]. Starch, a polysaccharide composed of glucose, is commonly used in food and has varying properties depending on its source and composition. Chitosan, a biocompatible polymer, is explored as a scaffold material due to its compatibility with cells and low cost [2]. Therefore, this study aims to produce edible chitosan/starch scaffolds coated with gelatin to promote cell adhesion and efficient cell growth in cultivated meat production.

II. MATERIALS AND METHODS

Edible scaffolds were fabricated using starch solutions with varying ratios to investigate the impact of composition on structural and functional properties. The starch solutions were heated and stirred until fully gelatinized, then cast into molds and allowed to dry under controlled conditions to form scaffold structures. Following scaffold formation, samples were characterized using scanning electron microscopy (SEM) to examine surface morphology and pore structure. Fourier Transform Infrared Spectroscopy (FTIR) was employed to confirm chemical composition and evaluate cross-linking reactions. Mechanical properties, including hardness and elasticity, were assessed using a texture analyzer. To assess cytocompatibility, bovine muscle stem cells (BMSCs) isolated from Hanwoo cattle were seeded onto the scaffolds. Cells were cultured in growth medium under standard conditions (37 °C, 5% CO_2) and monitored over several days. Cell attachment, proliferation, and viability were evaluated using live/dead staining and metabolic activity assays, providing insights into scaffold biocompatibility and suitability for cultured meat applications.

III. RESULTS AND DISCUSSION

The study focuses on characterizing chitosan/tapioca (CS/TA) scaffolds and assessing their compatibility with bovine muscle cells for potential tissue engineering applications.

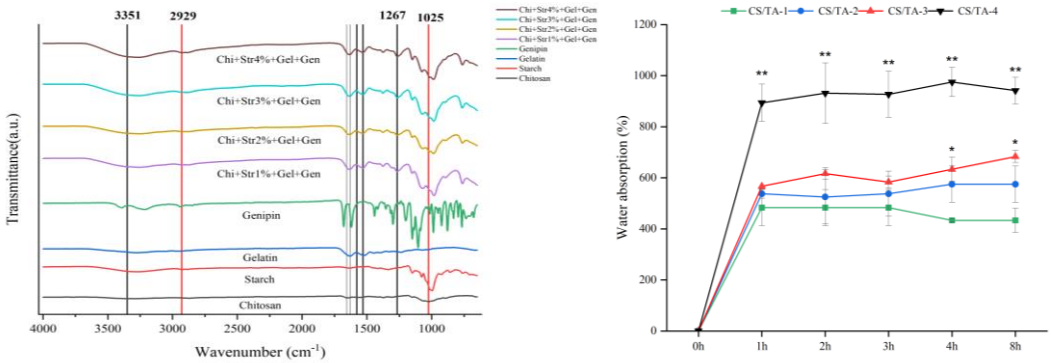


Figure 1. FTIR was used to measure the CS/TA scaffold and the components of the scaffold (left). Water absorption of CS/TA scaffolds (right). The results were expressed as means ± SD (n=6, *p<0.05 and **p<0.01).

SEM images reveal similar scaffold sizes regardless of starch concentration, but higher concentrations exhibit increased internal porosity, crucial for cell attachment and nutrient supply. Spectra indicate interactions between chitosan, tapioca starch, suggesting successful scaffold formation and increased starch concentration enhances water absorption, potentially aiding in nutrient transport to cells (Figure 1).

Starch concentration influences scaffold hardness and adhesiveness, with higher concentrations leading to increased adhesiveness but decreased chewiness. BMSCs exhibit higher attachment and proliferation rates on scaffolds with increased starch concentrations, particularly CS/TA-4 (Figure 2).

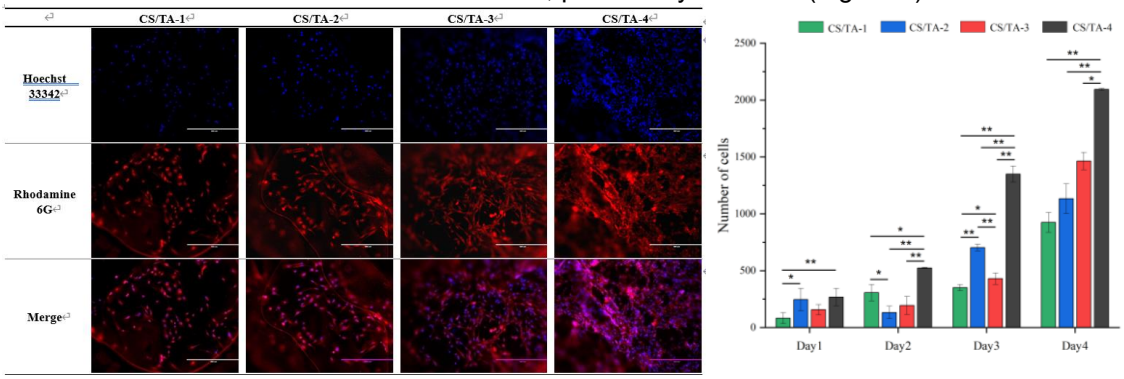


Figure 2. Staining Image of BMSC at day 7 in Different Concentration of Scaffold. Scale bar: 200 μm(100x)

Cell viability increases over time on all scaffolds, indicating efficient nutrient supply and scaffold compatibility. High porosity and water absorption of CS/TA-4 likely contribute to enhanced cell attachment and growth. BMSCs cultured on CS/TA-4 show potential for differentiation, as evidenced by cell fusion and attachment, despite the absence of myotube formation.

IV. CONCLUSION

Results from the current study unveils a biomimetic scaffold comprising chitosan and tapioca starch demonstrating enhanced cell attachment, proliferation, and viability, underscoring its potential for tissue engineering applications, including cultivated meat production. This research highlights the promising utility of biomimetic scaffolds in facilitating cell growth and differentiation, offering insights into advancing both agricultural and biomedical fields.

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