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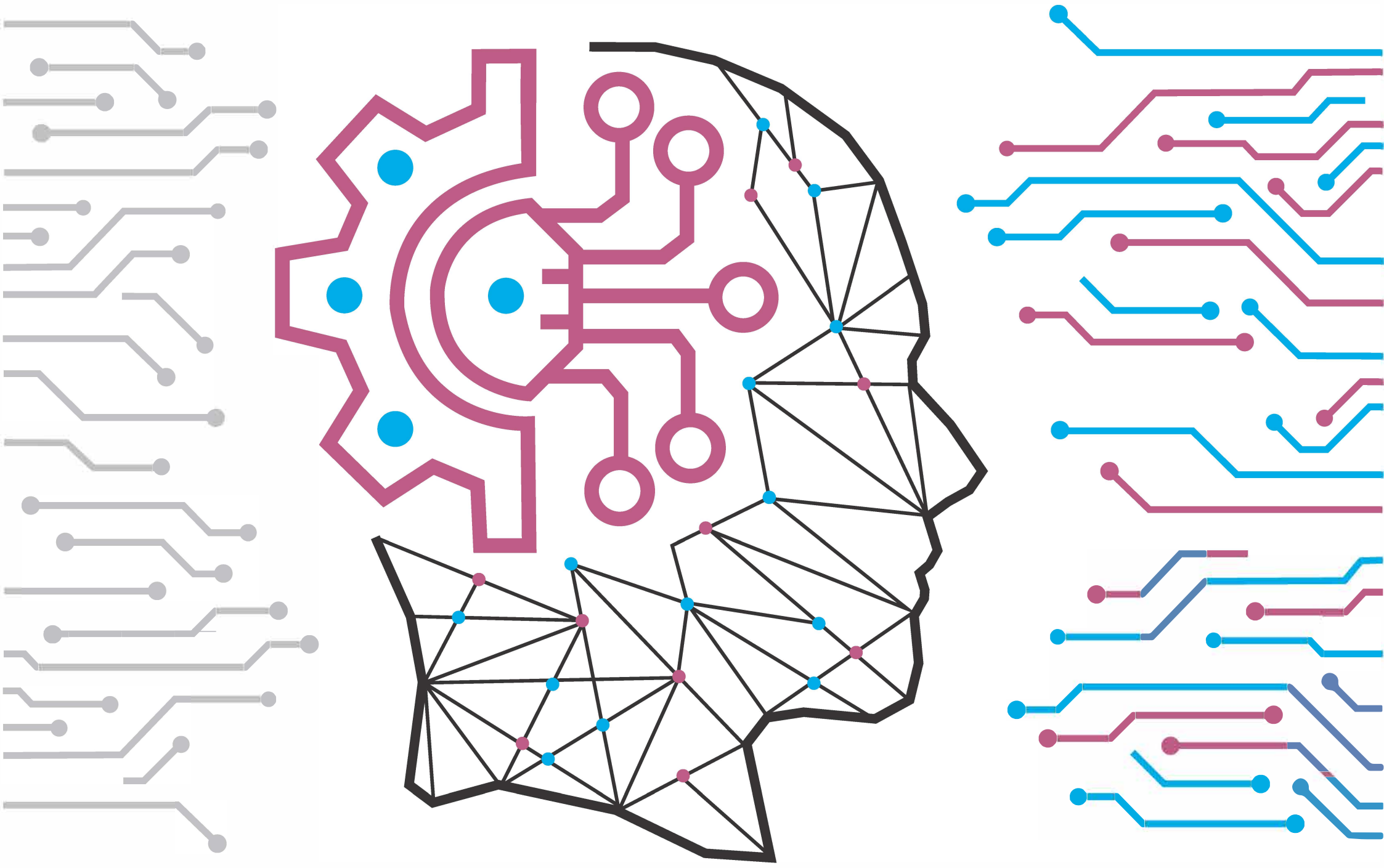

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THE 13TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

## EXTENDED ABSTRACTS

e-BOOK

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# CELLTRIX PRO: BIOENGINEERED SCAFFOLD KIT FOR SUCCESSFUL MSC DIFFERENTIATION

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The CellTrix Pro kit is an innovative biomaterial scaffold designed to facilitate the differentiation of mesenchymal stem cells (MSCs). This kit aims to address key challenges in tissue engineering and regenerative medicine by providing a scaffold that closely mimics the natural extracellular matrix that meet the structural and biological parameters, thus creating an ideal environment for MSCs growth and differentiation. The CellTrix Pro kit features a three-dimensional scaffold made from biocompatible and biodegradable materials, included with optimized cocktails of growth factors and growth media. These components are tailored to support MSCs differentiation to osteogenic, chondrogenic, and adipogenic. The porosity microarchitecture of the scaffold enhances cell viability, proliferation, and differentiation efficiency. *In vitro* studies demonstrated the kit's superior performance, showing a significant improvement in the speed and reliability of MSCs differentiation compared to conventional methods making it more efficient and reproducible for MSCs differentiation. The CellTrix Pro kit accelerates the production of high-quality, specialized cells suitable for various therapeutic applications with a straightforward and easy-to-follow protocol, ensuring that researchers can consistently achieve high-quality results. With broad applications in tissue repair, and disease modeling, CellTrix Pro kit offers a promising solution for treating degenerative diseases and injuries. It provides researchers with a powerful tool to advance stem cell biology and develop new therapeutic strategies. In conclusion, the CellTrix Pro kit represents a significant advancement in MSCs differentiation technology, with the potential to revolutionize regenerative medicine and improve patient outcomes.

***Keyword:*** scaffold, MSC differentiation, tissue engineering, regenerative medicine, extracellular matrix

## 1. INTRODUCTION

The development of bioengineered scaffolds that promote mesenchymal stem cells (MSCs) differentiation has greatly advanced the area of regenerative medicine. CellTrix Pro kit is an innovative product that has been intended to improve the efficiency and success rate of MSCs differentiation. This scaffold kit creates the ideal environment for stem cell growth and differentiation by utilizing sophisticated biomaterials. Mesenchymal stem cells are multipotent stromal cells capable of differentiating into a variety of cell types, including osteoblasts, chondrocytes, and adipocytes. Because of their versatility, MSCs are essential for tissue engineering and regenerative medicine study. However, cells microenvironment has a major influence on how well MSCs differentiate, and this is

where the CellTrix Pro kit comes into play. The CellTrix Pro kit comprises a bioengineered scaffold made from biocompatible and biodegradable materials that mimic the natural cells extracellular matrix (ECM). The ECM is essential for providing structural support and biochemical cues critical for cell attachment, proliferation, and differentiation (Frantz et al., 2010). By replicating these properties, the CellTrix Pro kit creates a conducive environment that enhances MSCs viability and differentiation potential. Recent studies have demonstrated that the physical and chemical properties of the scaffold, such as porosity, stiffness, and surface chemistry, significantly influence stem cell behavior (Engler et al., 2006; Discher et al., 2005). The CellTrix kit addresses these factors by incorporating tunable features that can be adjusted to meet specific differentiation requirements. This customization allows researchers to optimize the scaffold conditions for various applications, ranging from bone regeneration to cartilage repair.

## 2. METHODOLOGY

2.1 Cell culture

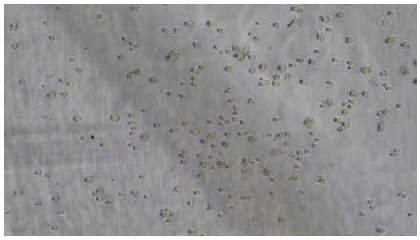
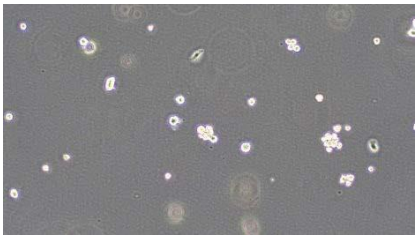
The frozen human umbilical cord mesenchymal stem cells (hUMSCs) were thawed in a 37°C water bath for less than 2 min to make sure it can dissolve in a short period of time. The hUMSCs were then cultured in T-25 flasks that contained complete media culture incorporated with DMEM F12, 10% foetal bovine serum (FBS), and 1% penicillin-streptomycin. The cell was incubated at 37°C in a humidified 5% $CO_2$.

2.2 Characterization of differentiated hUMSCs via flowcytometry analysis

Cultured hUMSCs were trypsinized and resuspended in staining buffer consist of 5% FBS and 1X PBS at final concentration of $1x10^6$ cell/ml for every sample. Four 12x75mm round-bottom tubes were labelled and 100µl of the hUMSCs cell suspension aliquoted to each of the tube. About 5µl of each monoclonal antibody marker, CD44, CD166, CD151, CD34, CD90, and CD73 were added into the round-bottom tubes and was pulsed vortex to mix. The samples were incubated on ice for 30 minutes in the dark and protected from the light. The cells were washed with cold staining buffer and centrifuged at 1500 rpm for 5 min at room temperature. Next, the cells were resuspended in the staining buffer and analyzed by using BD FACS CytoFLEX S.

## 3. FINDINGS

**Table 1**. Morphology of hUMSCs cultures at different stages of differentiation on scaffold and control well respectively (10X magnification).

| Days | Scaffold | Control |
|---|---|---|
| **1** |  |  |

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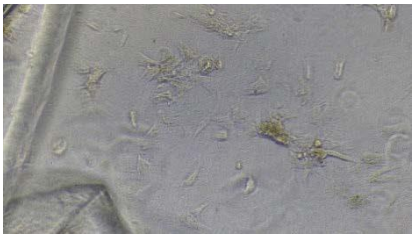
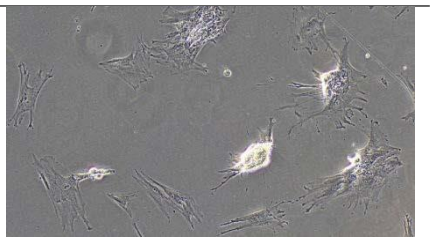
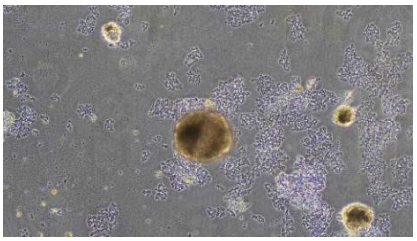
| **7** |  |  |
| **14** |  |  |

Cell differentiation was conducted on hUMSCs to achieve chondrocyte formation. The cells were plated on both fish hydrogel scaffold and conventional scaffold, which served as the control. Appropriate growth factors and growth media were supplemented in both setups. Results shown in **Table 1.** indicate that the chondrocyte spheroids developed on the fish hydrogel scaffold on Day-14 were significantly larger in diameter as compared to those grown on the conventional control scaffold. This demonstrates the superior effectiveness of the fish hydrogel scaffold in promoting chondrocyte spheroid growth.

## 4. CONCLUSION

In conclusion, by providing a consistent and supportive environment for MSCs differentiation, the CellTrix Kit not only facilitates more reliable experimental outcomes but also paves the way for advancements in clinical treatments for a wide range of conditions. Its integration into research and clinical practices promises to accelerate progress in developing effective regenerative therapies, ultimately improving patient outcomes and advancing the field of regenerative medicine.

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