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RESEARCH ARTICLE
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Assessment of stem cells growth characteristics ethyl gallate conjugated hydrogel

Muskan Soni[1], Ramya Ramadoss[2]*, Raghunandakumar[3], P.Bargavi[4], Sandhya Sundar[5], Suganya Panneer Selvam[6], Pratibha Ramani[7]

[1,2,5,6,7]Department of Oral Biology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, 600077, India

[3]Department of Pharmacology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, 600077, India

[4]Department of Oral Pathology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, 600077, India

***Corresponding author:** Ramya Ramadoss, Department of Oral Biology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, 600077, India

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ABSTRACT

Background: Stem cells are types of cells that can produce other cells which are able to develop into any kind of cells in the body. scaffolds are 3-D porous solid, that provides a spatial correct position of cell location .They hold enormous potential for tissue regeneration. Ethyl gallate exhibits non-toxic nature of cell line from different tissue origin ethyl Gallate also provides nutrition and has been proven.

Materials and methods: 20 ML of gelatin solution was taken and mixed or added with 20 MG of Gallic acid(ethyl Gallate). It is then poured into a dish (90 MM Patriplate). freezing it was done at 4°C for 12 hours in a 24L culture plate. Thin membrane is now fabricated and characterized by SEM and an anti-inflammatory test was also done.

Discussion: Gallic acid-based hydrogel was found to have a stimulatory effect on stem cell proliferation .Improved porosity of the hydrogel is also seen, to facilitate proliferation.

Conclusion: Gallic acid(Ethyl gallate) modified gelatin membranes seem to exhibit significant effect on stem cell growth, characteristics which can be effectively extrapolated to key regeneration strategies.

Keywords: *stem cell, Gallic acid, ethyl gallate, scaffold*

INTRODUCTION

Stem cells are unspecialized human body cells. They have the ability to self-renew and can develop into any cell of an organism. Stem cells can be found in both embryonic and adult cells. There are various levels of specialization. Each stage reduces developmental potency, which means that a unipotent stem cell cannot differentiate into as many different types of cells as a pluripotent one. Stem cells also function as the body's own repair systems. As long as an organism is alive, the replenishment and production of new cells are limitless.

Stem cell activity is determined by the organ in which they are found; for example, in bone marrow, division is continual, whereas in organs such as the pancreas, division occurs only under certain physiological conditions (1).Regenerative medicine is a field of medical research that focuses on replacing non-functional or dead cells, as well as repairing or regenerating tissues and organs to restore normal organ functions. Approaches used in regenerative therapy to achieve the goal include soluble biomolecules, stem cell transplants, tissue engineering, gene therapy, and cell reprogramming based on target tissue types. Stem cell transplantation and tissue regeneration strategies for treating various diseases have risen in popularity over the last few decades. Mesenchymal, hematopoietic, embryonic, mammary, intestinal, endothelial, neural, olfactory, neural crest, testicular, and induced pluripotent stem cells are examples of stem cells (2).

Tissue engineering, an allied subject of regenerative medicine, is a vital area of research that has received substantial attention in recent years. Biomaterials technology has progressed from a cell carrier tool to one that can influence cellular development. Biomaterials can now be sculpted into three-dimensional (3D) scaffolds to enhance cell proliferation and/or differentiation in order to regenerate tissues (3).

Scaffolds are 3D porous solid, that provides a spatially correct position of cell location. They hold enormous potential for tissue regeneration. Mechanical parameters such as matrix stiffness, matrix nanotopography, microgeometry, and extracellular stresses all have a big impact on stem cell activity. Biomaterials are classified as natural or synthetic polymers based on their origin. Collagen, silk fibroin, alginate, chitosan, keratin, and decellularized tissues such as de-epithelialized human amniotic membrane are some of the natural scaffolds utilized in tissue engineering (4).

The primary goal of constructing scaffolds for tissue regeneration is to replicate extracellular matrix (ECM) function in a temporally coordinated and spatially organized structure. A critical difficulty is encoding necessary biological signals inside the scaffold so that all aspects of cell response—adhesion and migration, proliferation, and phenotypic selection—can be managed (5) (6).

Ethyl gallate exhibit non-toxic nature of cell lines from different tissue origin. Ethyl gallate also provides nutrition. The pharmacological effects of ethyl gallate are stronger than those of other catechins. Ethyl gallate has anti-bacterial, anti-carcinogenic, anti-oxidative stress, and anti-inflammatory properties. Furthermore, Ethyl gallate's safety and cost-effectiveness promote its widespread medicinal application (2,7).

MATERIALS AND METHODS

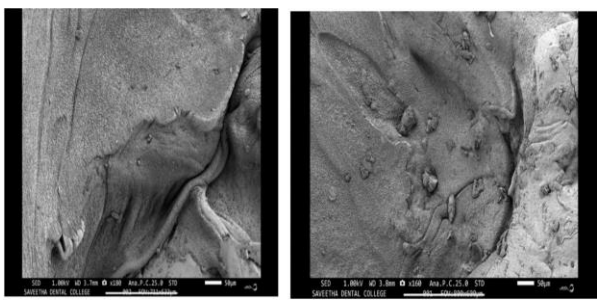
Ethyl Gallate (Gaelic acid) which helps to prevent infection. Helps in tissue regeneration. Gelatin Scaffold is a natural polymer containing 70 to 85% of collagen which helps in soft tissue regeneration.

- 20 MG of Gaellic acid is added or incorporated into a gelatin solution of 20 ML. It is then poured into a dish(90 MM petri plate)
- Freezed for 12 hours at 4°C in a 24L plate for culture.
- Then we can obtain a thin membrane which has been fabricated.

Then it is characterized by SEM and an anti-inflammatory test is also done to find the cytotoxicity effects of Gaellic acid loaded gelatin hydrogen on colorected spheroid cell lines.

Feel emission scanning electron microscope was used to visualize the gelatin solution incorporated Gallic acid on the glass coverslip at a magnification of 5µl. Section is then dehydrated with 70% ethyl alcohol for 10 seconds applied for drying. After the critical point section is then coated with platinum for 30 seconds to induce for FESEM. Images are then captured at an acceleration voltage of 3000 Kµ and observed.

RESULT



Scanning Electron Microscopy

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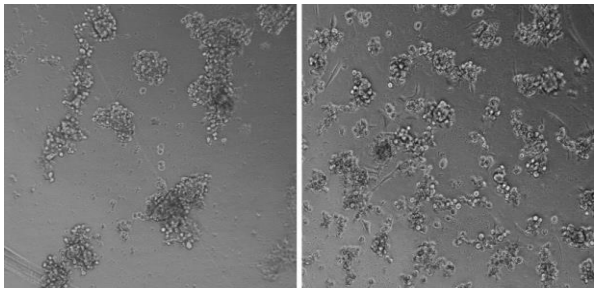
Cytotoxicity Effects of Gallic acid loaded alginate hydrogel on colorectal spheroid cell line

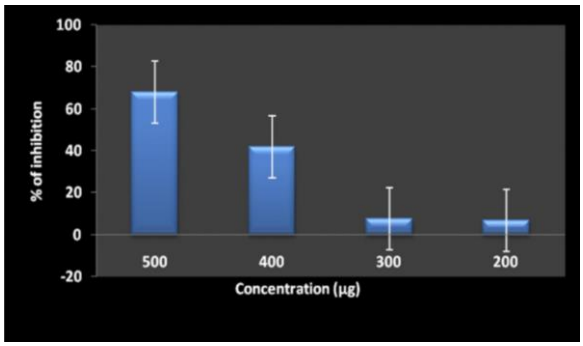


Alginate. Alginate + Gallic acid

Gallic acid loaded alginate hydrogels suppress the spheroid growth by inhibiting cell proliferation to the colorectal spheroid cell line.

The spheroid size clearly shows the cytotoxic effect of gallic acid loaded alginate hydrogel.

Anti Inflammatory Test



DISCUSSION

Stem cells are divided into cells with specialized function. These have specific functions, and can be grown into different types of cells like heart muscles and bones. Several types of stem cells are used for regeneration like embryonic Stem cell, adult stem cell and perinatal stem cell.

Tissue regeneration is introducing specific cell types or cell products to wounded tissues or organs in order to restore tissue and organ function. Through numerous means, stem cells can speed up tissue regeneration. A range of stem cells, including mesenchymal, embryonic, and induced pluripotent stem cells, have been demonstrated to support tissue regeneration(8) .

There is less understanding of an appropriate scaffold to support DPSCs in their regeneration of dental tissues. A very porous scaffold that mimics the natural extracellular milieu of dentin tissue is likely required for cell attachment, proliferation, differentiation, and neo tissue formation in order to achieve successful dentin tissue regeneration (9).

Scaffolds are essential in tissue engineering. They are designed to create synthetic ECM microenvironments for cell attachment, proliferation, differentiation, and neo tissue creation by acting as three-dimensional tissue templates. As a result, an advanced scaffold may benefit from emulating certain favorable aspects of the natural ECM. Collagen type I comprises 80-90% of the organic components in demineralized dentin ECM and is directly associated with dentin development. (10)(11)

In the SEM images, we can confirm that gelatin modified with gallic acid has a higher number of cells compared to gelatin solution alone. This gallic acid-based hydrogel has been found to have a stimulatory effect on stem cell proliferation. Improved porosity of hydrogen is also seen, which is helpful in increasing proliferation.

In the SEM images we can confirm that gelatin modified with Gallic has more number of cells compared to gelatin solution alone. This gallic acid based hydrogel is found to have a stimulatory effect on stem cell proliferation. Improved porosity of hydrogen is also seen which is helpful in increased proliferation. Another investigation into the use of EGCG to increase macrophage adhesion discovered that the surface morphology of the compound had changed, with smaller fiber branches extending from the backbone and a more coherent arrangement, which may be responsible for the survival and attachment of the cells (12).

We observed an anti-inflammatory response of ED. Ethyl gallate has anti-inflammatory properties, which support its application in tissue regeneration.

Ethyl Gallate was discovered to have the least cytotoxic effect. A study found that Ethyl gallate caused cytotoxicity in a dose-dependent way. A concentration of 50 g/mL ethyl gallate was shown to be highly beneficial for proliferation (13). A different cytotoxicity analysis showed that the modified hydrogel was active and that its

concentrations were >100 g/mL for Vero cell lines and 72 g/mL for Hela cell lines. The drug's cytotoxic action and lack of toxicity were revealed by the fact that it had no hemolytic activity against rat and human erythrocytes (14).

Another study showed that NF scaffolds are a promising candidate for dentin tissue engineering. When compared to control scaffolds, the NF scaffolds improve hDPSC odontogenic differentiation. hDPSCs developed into odontoblasts when seeded on NF scaffolds in both 'Dex' and 'BMP-7 + Dex' medium(15)

In similar studies it is found that matrix stiffness of the scaffold regulates differentiation potential and high stiffness favors osteogenesis. Different cells respond differently to hydrogen-based scaffolds and later adapt their distribution and morphology.

Other studies say hydrogen is really used alone and research uses them in combination for their bio material properties. Different shape composition, bio function and molecule signaling respond differently for different differentiation and fiber growth of cells.

In a previous study gelatin/PVA formed hydrogel was tested and showed that gelatin PVA supported proliferation, calcium deposition and cell addition. Also demonstrated structural formation for tissue regeneration.

The cytotoxic assays, SEM and confocal analysis of human fibroblasts in contact with ChMA : GelMA hydrogel. It demonstrated that they are biocompatible and are able to support cell adhesion on their surface and also allow cellular internalization and secondly The chemical modification of Ch and gelatin allowed the production of a stable 3D network in situ, through their exposure to UV light. Moreover, the produced hydrogels offer a moist environment, possess a porous structure, a high water uptake capacity and are biodegradable. (16).

In vitro degradation assay and growth factor release assay. HPL-incorporated hydrogel significantly enhanced angiogenesis relative to the hydrogel group, indicating a great potential in promoting angiogenesis (17)

Biocompatibility assessment,Bone defect model construction and stent implantation, Histomorphological test was done . Bone marrow mesenchymal stem cells (BMSCS) were encapsulated in Bio-GelMA scaffolds to examine the therapeutic effects of ECM-loaded cells in a 3D environment simulated for segmental bone defects. In vitro results showed that Bio-GelMA had good biocompatibility and sufficient mechanical properties (18)

Our team has extensive knowledge and research experience that has translate into high quality publications(19–28)

CONCLUSION

Gallic acid incorporator gelatin membrane seems to exhibit a significant effect on stem cell growth characteristics which can be effectively extrapolated to key regeneration strategies.

CONFLICT OF INTEREST

No interest.

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