FABRICATION OF HYDROXYAPATITE AND CISSUS QUADRANGULARIS INCORPORATED TR MEMBRANE FOR GUIDED TISSUE REGENERATION

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Abstract:

Aim: To fabricate a hydroxyapatite and *Cissus quadrangularis*-incorporated TR membrane for guided tissue regeneration (GTR). **Objective:** To develop and evaluate the biocompatibility, contact angle, and structural characterization of the membrane using a scanning electron microscope (SEM). **Summary:** Guided tissue regeneration (GTR) is a crucial technique in periodontal therapy, aiming to restore lost alveolar bone and periodontal support structures. Hydroxyapatite (HA), a calcium phosphate-based bioceramic, is widely recognized for its excellent biocompatibility, osteoconductivity, and role in bone regeneration. *Cissus quadrangularis*, a medicinal plant, has been reported to accelerate bone healing and reduce inflammation. In this study, a TR membrane incorporating hydroxyapatite and *Cissus quadrangularis* was fabricated and characterized for its potential use in periodontal regeneration. The membrane's surface properties, biocompatibility, and wettability were analyzed using SEM and contact angle measurements. The integration of HA and *Cissus quadrangularis* is expected to enhance the regenerative potential of the membrane, making it a promising biomaterial for periodontal applications.

Keywords: Hydroxyapatite, *Cissus quadrangularis*, guided tissue regeneration, TR membrane, biocompatibility, periodontal therapy.

INTRODUCTION:

Hydroxyapatite (HA) is an inorganic mineral present in human bone and teeth. It plays a role in the structural strength of bone and in bone regeneration.Polyvinyl alcohol, which is essentially made from polyvinyl acetate through hydrolysis, is easily degradable by biological organisms and in water is a solubilized crystalline structure polymer. C. quadrangularis helps in reducing pain, swelling, and fracture mobility and accelerate the healing of fracture jaw bones.The ambitious goal of periodontal regenerative therapy is to regenerate lost/damaged support tissue in the periodontium, which includes the alveolar bone, periodontal ligament, and cementum, in order to effectively reduce tooth loss caused by periodontitis. In dentistry, guided tissue regeneration

(GTR) is a current technique used for periodontal surgery, enabling osseous regeneration before soft tissue migration into the targeted area. Bio ceramics, such as calcium phosphate-based bone grafts exhibit the highest similarity to the mineral found in bone. This gives calcium-phosphate excellent biocompatibility, biodegradability, and osteoconductivity. The aim of the study is to fabricate hydroxyapatite and cissus quadrangularis incorporated TR membrane for guided tissue regeneration.

ATERIALS AND METHODOLOGY:

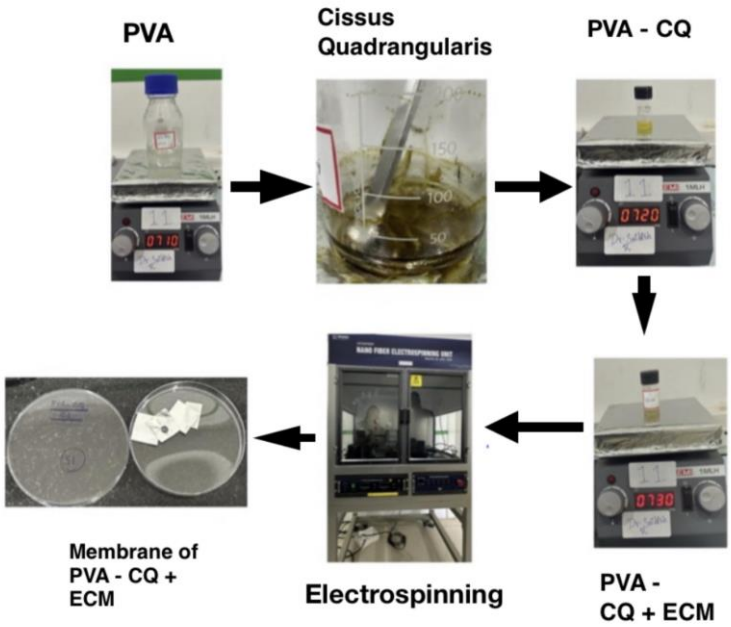

Fig:1

In figure the materials and methodology was explained pictographically, the Hydroxyapatite powder: This is a biocompatible ceramic material commonly used in bone tissue engineering. Polyvinyl alcohol: which is essentially made from polyvinyl acetate through hydrolysis, is easily degradable by biological organisms and in water is a solubilized crystalline structure polymer.Cissus quadrangularis extract: This plant extract is known for its potential in promoting bone regeneration and wound healing. Preparation of hydroxyapatite and Cissus quadrangularis incorporation: Mix the hydroxyapatite powder with the Cissus quadrangularis extract to form a homogeneous mixture.Preparation of polymer solution: Dissolve in poly vinyl alcohol.Membrane fabrication:Mix the hydroxyapatite-Cissus quadrangularis mixture with the poly vinyl alcohol solution. Pour the mixture into tissue culture plates. Allow solvent evaporation to form a solid membrane. Conduct analyses like scanning electron microscopy (SEM), biocompatibility , and contact angle is measured by goniometer to characterize the membrane's properties. Biocompatibility- Cell culture studies demonstrate good cell adhesion and proliferation on the

membrane surface.The MTT assay indicates that the membrane supports cell viability, confirming its biocompatibility.

RESULTS:

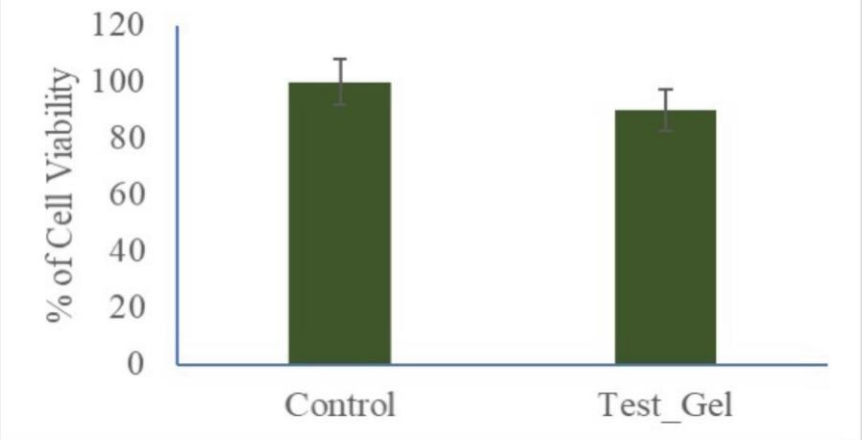

FIGURE :2 - BIOCOMPATIBILITY

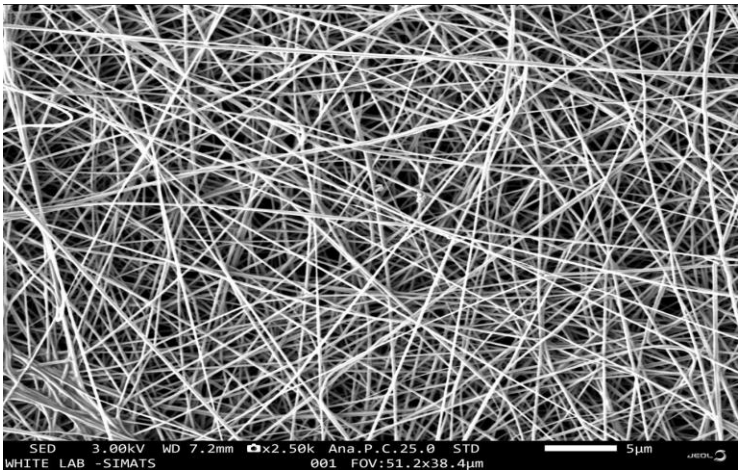

FIGURE 3 : SEM

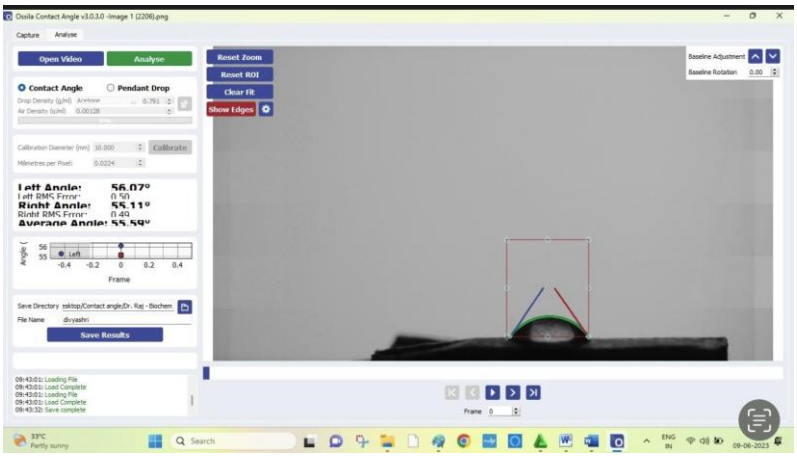

FIGURE 4 :CONTACT ANGLE

DISCUSSION:

In figure 2 Biocompatibility- Cell culture studies demonstrate good cell adhesion and proliferation on the membrane surface.The MTT assay indicates that the membrane supports cell viability, confirming its biocompatibility. In figure 3 SEM images show uniform distribution of HAp particles and CQ within the PLGA matrix.The membrane surface appears porous, which is beneficial for tissue ingrowth. In figure 4 the contact angle explains that the In vitro cell culture shows that the PVA - CO modified membrane has a better biocompatibility and promotes cell proliferation compared with pure PVA. Besides, it can also prevent fibroblasts invasion. Therefore, biodegradable electrospun PVA membrane have greater opportunity to be used as guided regeneration membrane for treating periodontitis.The incorporation of HAp and CQ into the PLGA membrane successfully enhances its bioactivity, mechanical properties, and biocompatibility.

The osteoconductive nature of HAp, combined with the regenerative properties of CQ, provides a synergistic effect that promotes bone healing. The membrane's controlled degradation rate ensures it remains functional during critical stages of tissue regeneration.The newly developed TR membrane shows significant potential for improving the outcomes of GTR procedures. Its enhanced bioactivity and biocompatibility could lead to faster and more effective bone healing, reducing recovery times and improving patient outcomes.In order to prevent inflammation and bacterial infection, the GTR approach applies a physical barrier to the exposed root surface to limit epithelial downgrowth. This process is known to obstruct the creation of new attachment components. Apart from the aforementioned advantages, GTR can function as drug carriers, facilitating the long-term delivery of pharmaceuticals into the oral cavity with negligible side effects (Mondal and Pal, 2019, Pretzl et al., 2009, Sethiya et al., 2022).

In a study, nano composite membranes for periodontal regeneration were modified using polycaprolactone (PCL), polyethylene glycol (PEG), and bioactive glass nanopowders (BGs) (Dehnavi SS et al.,)Barrier Function Preventing epithelial down-growth into the defect site, thus maintaining space for new bone and tissue formation.Enhanced Osteogenesis HA promotes the

migration and differentiation of osteoblasts, while CQ enhances collagen synthesis and bone matrix formation.Anti-inflammatory Effects CQ's anti-inflammatory properties help reduce post-surgical inflammation, promoting faster healing and tissue integration.

The development of a hydroxyapatite and Cissus quadrangularis incorporated TR membrane represents a significant advancement in guided tissue regeneration. The combined properties of HA and CQ within a biocompatible and mechanically robust TR matrix offer promising potential for enhancing periodontal and bone regeneration outcomes. Future studies focusing on in vivo performance and clinical trials will be essential to validate the efficacy and safety of this novel GTR membrane.

CONCLUSION:

PVA was chosen in combination with hydroxyapatite as a facilitator laver for use as a membrane to provide mechanical support and prevent rapid epithelial attachment or promote target cell proliferation

FUTURE SCOPE:

Our study proposes a method for the preparation of PVA hydrogel membranes with good cytocompatibility and degradation resistance. Further studies should be done in animal model. And we should check the mechanical property, toxicity, strength of the membrane

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