WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Synthesis and Characterization of Banana Fiber Conjugated Gel Scaffold for Dual Responsive Drug Delivery in Breast Cancer

Lavanya S[1], Liji M[1], Pandeeswari B[1], Sneka T[1], Ms. R. Shamli[2]

[1]IV Year, Department of BME, Paavai college of Engineering, Namakkal

sivakumarxxx7@gmail.com, lliji3900@gmail.com, pandees1906@gmail.com, snekathiyagarajan@gmail.com.

[2]M. Tech, Assistant Professor, Department of BME, Paavai college of Engineering, Namakkal. 2shamliramamoorthy98@gmail.com

ABSTRACT:

The utilization of natural fibers in biomedical applications has gained significant attention due to their biocompatibility and sustainability. In this study, we present the characterization and synthesis of a novel banana fiber scaffold for dual-responsive drug delivery in breast cancer treatment. Banana fibers were isolated from banana peel using a hypochlorite solution and sulfuric acid. The resulting fibers were further processed into a powder form. This powder was then mixed with water and chitosan nanoparticles (CS NP) to form a composite scaffold. The scaffold was subjected to stirring followed by sonication and stored at -20°C for further analysis.

Characterization of the scaffold was carried out to assess its physical and chemical properties. Morphological analysis revealed the fibrous structure of the scaffold, while spectroscopic techniques confirmed the presence of functional groups characteristic of both banana fibers and chitosan nanoparticles. The scaffold demonst rated excellent biocompatibility when tested with breast cancer cells in vitro.

KEYWORDS: Biomaterials, Banana fibre, Chitosan, Hypochlorite sodium, Drug Delivery, Scaffold, Synthesis, Characterization.

1. INTRODUCTION:

Breast cancer is the most common cancer diagnosed in women, accounting for more than 1 in 10 new cancer diagnoses each year. It is the second most common cause of death from cancer among women in the world. Anatomically, the breast has milk-producing glands in front of the chest wall. They lie on the pectoralis major muscle, and there are ligaments support the breast and attach it to the chest wall. Fifteen to 20 lobes circularly arranged to form the breast. The fat that covers the lobes determines the breast size and shape. Each lobe is formed by lobules containing the glands responsible for milk production in response to hormone stimulation. Breast cancer always evolves silently. Most of the patients discover their disease during their routine screening. Others may present with an accidentally discovered breast lump, change of breast shape or size, or nipple discharge. However, mastalgia is not uncommon. Physical examination, imaging, especially mammography, and tissue biopsy must be done to diagnose breast cancer. The survival rate improves with early diagnosis. The tumor tends to spread lymphatically and hematologically, leading to distant metastasis and poor prognosis. This explains and emphasizes the importance of breast cancer screening programs.

2.PROPOSED WORK:

To investigate the potential of banana fiber as a scaffold material for drug delivery applications targeting breast cancer. The study aims to characterize the properties of banana fiber, synthesize a scaffold using this material, and evaluate its responsiveness to dual stimuli for controlled drug release specifically tailored for breast cancer therapy.

3.LITERATURE REVIEW:

3.1 Natural Fiber Scaffolds for Drug Delivery:

Natural fibers, derived from plants, animals, or minerals, offer unique properties such as biodegradability, biocompatibility, and low cost, making them attractive candidates for drug delivery systems. Various natural fibers, including silk, chitosan, cellulose, and collagen, have been extensively investigated for their potential in drug delivery applications. These materials have been utilized to develop scaffolds capable of controlled drug release, targeted delivery, and tissue engineering.

3.2 Banana Fiber as a Drug Delivery Carrier:

Banana fiber, a lignocellulosic material obtained from the stem of the banana plant, has gained attention in recent years due to its abundance, renewability, and biocompatibility. Studies have demonstrated the feasibility of using banana fiber as a drug delivery carrier due to its porous structure, high surface area, and ability to undergo surface modification. Additionally, banana fiber exhibits dual responsiveness, allowing for stimuli-responsive drug release triggered by changes in pH and temperature, which are common features of the tumour microenvironment.

3.3 Previous Research on Banana Fiber Scaffold for Drug Delivery:

Several studies have explored the synthesis, characterization, and drug delivery potential of banana fiber scaffolds. These studies have investigated various fabrication techniques, including electrospinning, freeze-drying, and solvent casting, to develop scaffolds with tailored properties such as porosity, morphology, and drug-loading capacity.

3.4 Challenges and Future Directions:

Despite the promising results, several challenges remain in the utilization of banana fiber scaffolds for drug delivery in breast cancer therapy. These challenges include achieving sustained drug release kinetics, improving scaffold biodegradability, enhancing tissue compatibility, and ensuring scalability for clinical translation. Future research efforts should focus on addressing these challenges through advanced fabrication techniques, biomaterial engineering, and in vitro/in vivo evaluations to accelerate the development of effective and clinically relevant drug delivery systems based on banana fiber scaffolds.

4.MATERIALS AND METHODS:

4.1 Materials Required:

Chitosan, Hydrochloric acid (HCI), Sodium Tri Phosphate Pentabasin (TPP), Hyaluronic Acid, Acetic acid, Doxorubicin, Banana peel, Sodium chlorite solution, Glutaraldehyde, Hydrogen Sulphate(H2SO4) Phosphate Buffered Saline (PBS), Fluoresceine isothiocyanate (FITC), Sodium Chloride (Nacl), Potassium Chloride (KCl), Disodium Phosphate (Na2HPO4), Mono-potassium phosphate (K*H{2} *P*O{4})

4.2 Preparation of chitosan nanoparticles:

1500 mg of chitosan was dissolved in 20 ml water &add with 5 ml acetic acid. Then 500 mg of sodium was added in TPP solution. After that sodium TPP was added dropwise into mixture and was kept for 12 hours. After completely dissolved, the mixture was centrifuged at 4000 rpm for 20 minutes. Supernatant was discarded. Pellet was dried and used for characterization.

4.3 Banana fiber isolation:

30 ml of hypochlorite solution was prepared and added in 5 ml H_2SO_4 solution. 12 g of banana peel were smashed and added into the solution followed by stirrer for overnight. The mixture was centrifuged at 4000 rpm for 15 minutes. Supernatant was discarded and pellet was kept it for dried.

4.4 Preparation of final sample:

Dried banana peel was made into powder and 20 ml of water was added in 0.2 g of banana peel powder &was kept in stirrer for 1 1/2 hours. After that 0.2 g of CS NP was added and kept in stirrer for I hour. Then it was sonicated for 30 minutes and storedin-20°C.

4.5 FITC loaded sample preparation:

0.5 g of chitosan nanoparticle was dissolved in 20 ml of water and 5 ml acetic acid was added. After fully mixing 0.5 g of sodium TPP was added in 20 ml water dropwise and kept for 12 hours. After that 500 ul of FITC was added into the mixture and keep it in stirrer for 1 hour. Then after dried it was smashed to get powder form. 10 ml of water was added in banana fiber powder and keep it in stirrer for 30 minutes. 0.2 g of chitosan nanoparticle conjugated hyaluronic acid was added in FITC and kept in stirrer for 1 hour.

5. CONCLUSION:

In conclusion, banana fiber shows promise for dual-responsive drug delivery in breast cancer treatment due to its abundance and biocompatibility. Overcoming challenges like sustained drug release and scalability is crucial for its clinical use. Future research should focus on addressing these obstacles to fully exploit banana fiber's potential in breast cancer therapy.

6. RESULT:

Preparation and characterization of BF-HA-CS scaffold:

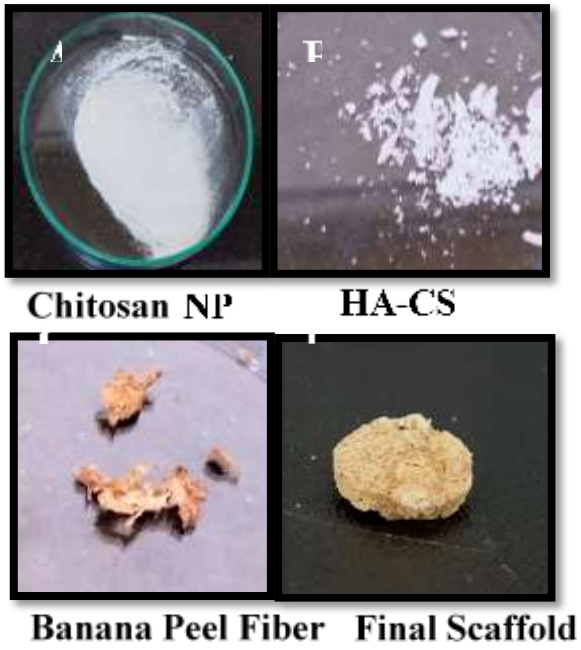

Figure: Chitosan nanoparticle (A), Chitosan conjugated hyaluronic acid, (B) Isolated banana fiber from banana peel (C), Final BF-HA-CS scaffold (D)

SEM:

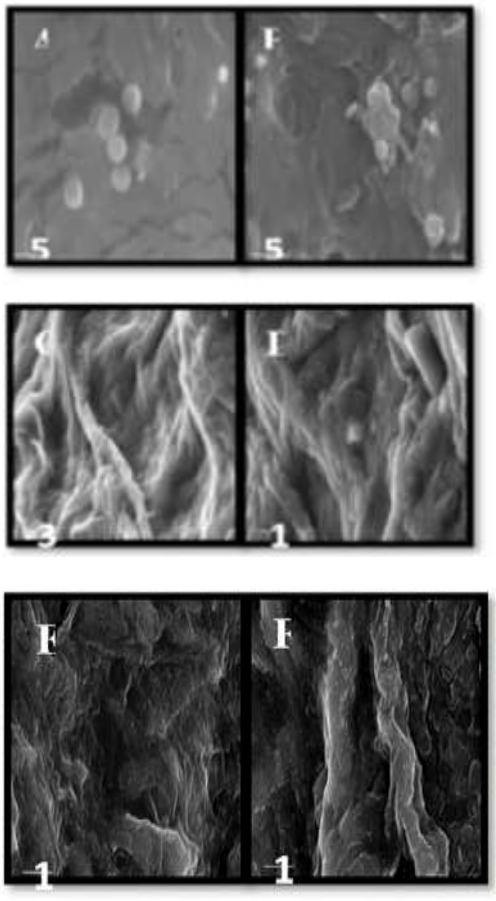

Figure: (A, B) Chitosan nanoparticle SEM image, (C, D) Banana fiber SEM image, (E, F) HA-CS coated banana fiber SEM image

FTIR:

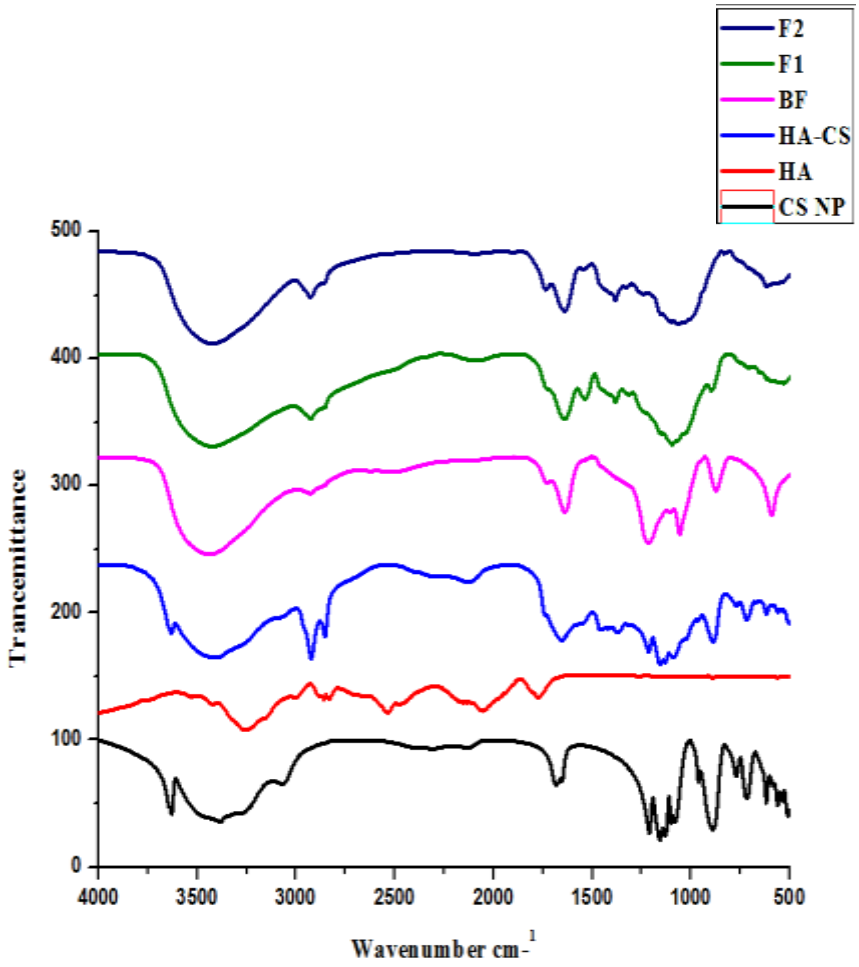

Figure: FTIR analysis of CS NP, HA, HA-CS, BF, 2% HA-CS conjugated BF (F1) and 5% HA-CS conjugated BF (F2)

7.FUTURE WORK:

Natural Scaffold is a class of new therapeutic material that meet the necessities such as biocompatibility, bio functionality, and tunable properties for therapeutic agent delivery. We prepared hyaluronic acid functionalized chitosan nanoparticle conjugated banana fiber scaffold. BF-HA-CS scaffold and their controlled release in response to redox and pH. Hyaluronic acid (HA) is a natural polymer act as a ligand was used to conjugate with CS in order to increase the surface characteristics of the prepared composite material. This natural scaffold is the right prime for targeting cancer cells. As all components are biodegradable, biocompatible and natural polymers so a strong cellular internalization was exhibited without any toxicity. The prepared conjugated material (BF-HA-CS) formed fibral shaped scaffold which have high potential for drug loading and can be developed for anticancer applications.

8. REFERENCE:

1. Madani SY, Naderi N, Dissanayake O, Tan A, Seifalian AM. A new era of cancer treatment: carbon nanotubes as drug delivery tools. Int J Nanomedicine. 2011:6:2963-2979.

2. Wicki A, Witzigmann D, Balasubramanian V, Huwyler J. Nanomedicine in cancer therapy: challenges, opportunities, and clinical applications. J Control Release. 2015;200:138-157.

3. DeSantis C, Siegel R, Bandi P, Jemal A. Breast cancer statistics, 2011. CA Cancer J Clin. 2011;61(6):409-418.

4. Torre LA, Bray F, Siegel RL, Ferlay J. Lortet-Ticulent J, Jemal A. Global cancer statistics, 2012. CA Cancer J Clin. 2015;65(2):87-108.

5. Probst CE, Zrazhevskiy P, Bagalkot V, Gao X. Quantum dots as a plat- form for nanoparticle drug delivery vehicle design. Adv Drug Deliv Rev. 2013;65(5):703-718.

6. Wang Y, Chen L. Quantum dots, lighting up the research and develop- ment of nanomedicine. Nanomedicine. 2011;7(4):385-402.

7. Couvreur P. Nanoparticles in drug delivery: past, present and future. Adv Drug Deliv Rev. 2013;65(1):21-23.

8. Lehner R, Wang X, Marsch S, Hunziker P. Intelligent nanomaterials for medicine: carrier platforms and targeting strategies in the context of clinical application. Nanomedicine. 2013;9(6):742-757.