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## Synthesis and Characterization of Food Packaging Film using Green Material Based on Agarose

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**ABSTRACT:** The biopolymer films are biodegradable and environmentally friendly, but they have some poor characteristics like low thermal stability, gas barrier properties, tensile strength, and elasticity. So, we used the filler as a supporting agent to develop the polymer character. Here, for the first time, we used the Agarose biopolymer modified with papain incorporated silicate composite biofilm-. Firstly, the composite films were prepared with 5% papain enzyme incorporated silicates and AgNO3 0.01mol with 1g of Agarose and 2% of polyvinyl alcohol, using glycerol as a plasticizing agent which gives food packaging film.

All the composite films were characterised by thermal analysis DSC,morphology was tested for PXRD and SEM techniques, and they were tested against gram-negative (Escherichia coli) and gram-positive (Staphylococcus aurous) bacteria for food packaging applications.

KEYWORDS: Silicate, papain, agarose biopolymer, PVA, glycerol, PXRD, SEM, food packaging film.

#### I. INTRODUCTION

In response to the global environmental crisis caused by conventional plastic packaging, there has been a growing demand for sustainable alternatives. Biopolymer films derived from natural sources have emerged as promising candidates due to their biodegradability and renewable nature. Among these biopolymers, agarose, extracted from seaweed, stands out for its biocompatibility and abundance. However, agarose-based films often exhibit poor mechanical properties and barrier characteristics, limiting their applications, particularly in food packaging.

To address these limitations, this study focuses on enhancing the properties of agarose-based films for food packaging applications. Specifically, we investigate the synthesis and characterization of a novel green material, incorporating additives such as papain and silicates, to improve the performance of agarose films. Papain, a proteolytic enzyme derived from papaya, offers unique bioactive properties that can potentially enhance the structural integrity and functionality of biopolymer films. Silicates serve as reinforcing agents to improve mechanical strength and barrier properties.

#### II. RELATED WORK

Previous research in the field of biopolymer films has explored various approaches to enhance their properties. Some studies have focused on incorporating nanomaterials such as nanoparticles and nanocellulose to improve mechanical strength and barrier properties. Others have investigated the use of natural additives like essential oils and antimicrobial peptides to impart antimicrobial properties to the films. However, to the best of our knowledge, there is limited research on the synergistic effects of papain and silicates in enhancing the properties of agarose-based films for food packaging.

#### **III. METHODOLOGY**

1.**PREPARATION OF AGAROSE SOLUTION:**Agarose powder is dissolved in a solvent such as water or an ionic liquid to form a homogeneous solution. The concentration of agarose is optimized based on desired film properties.



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**2.INCORPORATION OF PAPAIN:** Papain enzyme is added to the agarose solution at various concentrations to investigate its effect on film properties. The mixture is stirred thoroughly to ensure uniform dispersion of papain.

**3.SYNTHESIS OF SILICATE COMPOSITE**: Silicate nanoparticles are synthesized using aion exchange method and then dispersed in the papain solution. The concentration of silicates is varied to study their influence on film properties.

**4.FILM CASTING:**The agarose-papain-silicate mixture is poured into a casting moulding and allowed to dry under controlled conditions to form thin films. Parameters such as casting temperature and drying time are optimized to ensure homogeneous film formation.

**5.CHARACTERIZATION:** The synthesized films are characterized using various analytical techniques to evaluate their physical, mechanical, and barrier properties. Techniques such as scanning electron microscopy (SEM), X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FTIR) are employed to analyze film morphology, crystallinity, and chemical composition. Mechanical properties such as tensile strength and elongation at break are determined using mechanical testing equipment. Barrier properties, including water vapor transmission rate (WVTR) and oxygen permeability, are measured using standard methods. Antimicrobial activity is assessed through bacterial inhibition assays against relevant foodborne pathogens.

#### **IV. RESULT AND DISCUSSION**

The synthesized films exhibit improved thermal stability, mechanical strength, and barrier properties compared to pure agarose films. SEM analysis reveals uniform dispersion of papain and silicates within the agarose matrix. PXRD analysis confirms the presence of crystalline phases in the films. Antimicrobial testing demonstrates the efficacy of the films against both gram-negative and gram-positive bacteria, indicating their potential for food packaging applications.

#### V. CONCLUSION AND FUTURE WORK

In conclusion, this study demonstrates the successful synthesis and characterization of a novel food packaging film using agarose as a base material. The incorporation of papain and silicates enhances the mechanical and barrier properties of the films, making them suitable for food packaging applications. Future research could focus on optimizing the formulation and processing parameters to further improve film properties. Additionally, exploring other green additives and their synergistic effects could broaden the scope of applications for agarose-based films. Overall, this research contributes to the development of sustainable packaging solutions with improved performance characteristics.

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