



**SYNTHESIS, CHARACTERIZATION AND ANTIBACTERIAL APPLICATIONS
OF GUAR GUM -CHITOSAN WITH EXTRACTION OF CLOVE**

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ABSTRACT

In this work, guar gum (GG) and chitosan (CH) crosslinked composite film is prepared with extraction of *Syzygium aromaticum* (clove) and the synthesized film is characterized by various techniques such as X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy. The antibacterial activity of GG/CH film with clove oil was tested against *E.coli*.

Keywords: Guar gum, chitosan, clove, antibacterial

1. INTRODUCTION:

A polymer is a natural or man-made compound fabricated of macromolecules (large molecules) that are multiples of monomers (small chemical units) [1]. Many of the components found in living creatures are polymers, such as proteins, cellulose, and amino acid, make up many of the components present in living beings. Minerals like diamond cubic, natural glass, and moonstar, as well as man-made products like concrete, glass, paper, plastic, and

rubber, use it as a substructure. Some common examples of synthetic polymer are polyethylene, polystyrene, synthetic rubber, nylon and many more. Both synthetic and natural polymers are synthesis by polymerization. The use of polymer is spreading due to its unique properties which include, low density, superior thermal/electrical insulating capabilities, low cost. The qualities of polymer can be enhanced for specific use by combining it

with other material, such as composites. They are widely used as packaging application, medicinal application, personal hygiene and healthcare, construction and structural application, paints and lubricants, household item etc. polymers have high strength, they are resistance to corrosion, there are three classes of polymer-thermoplastic, thermoset and elastomer. Polymers are fabricated into useful items by using following techniques -calendering, extrusion, casting, molding, blowing, foaming, spinning of fibers, etc. The quality of a packaged material is determined by the type of material used in packaging material, the setting under which they are used, which in turn determine their application.

1.1 Chitosan:

Chitosan (CH) and chitin are highly recommended in the application of biomedicine, agriculture, biotechnology and food industry due to their bioactivity, biocompatibility and biodegradability [2]. Bio-based polymers and new process methods are gaining popularity as a way to reduce reliance on crude oil & transition to a material foundation that is long lasting. CH (cationic (1-4) -2-amino-2-deoxy-d-glucan) is a biopolymer produced from fully or partially deoxy-d-glucan in most cases. Chitin that has been deacetylated. After

cellulose, CH is the second most prevalent polysaccharide in nature. Because of its non-toxicity, it has gotten a lot of interest in the field of food packaging [3]. Biocompatibility, flexibility, biodegradability, and antibacterial characteristics were all considered .In agriculture, CH is considered as natural seed treatment and it enhances seed growth it is ecofriendly biopesticide which defend against fungal growth [4]. In medical field, Some wound dressings contain chitosan, which helps to reduce bleeding. The bandage becomes incredibly sticky when it comes into touch with blood, and this adhesive-like action seals the cut. Chitosan may also be used as a burn dressing since it inhibits the growth of bacteria and fungi [5-7].

1.2 Guargum:

Guar gum (GG) is a water-soluble polysaccharide made up of a linear chain of -1, 4-linked mannose and 1, 6-linked galactose derived from guar beans. Galactose was primarily used as a food-grade integrated gradient in bio-nanocomposites uses for packaging [8]. Most organic solvents are insoluble in guar gum. Due to its high molecular weight (20,000-30,000), it can create a high viscosity aqueous solution at low temperatures [9]. It maintains its stability in the pH levels in the range of 5-7, on the

other hand at basic pH and higher temperatures, it degrades. It is used as a thickening, dough improver, binder, and for the preservation of food and beverages. And also, reduces the amount of oil used in fried dishes [10]. Guar gum industrial application includes, paper industry (as to improve sheet formation, folding and denser surface for printing), cosmetic industry (as thickener in shampoo, conditioners, toothpaste), explosive industry (as waterproofing agent by blending with nitroglycerin, ammonium nitrate) pharmaceutical industry (as binder or fragments in tablets and bulk forming laxatives) , hydraulic fracturing (due to intermolecular hydrogen bonding ,it has tendency to aggregate during hydraulic fracturing which clog the fractures and restrict the flow of oil) etc. [11].

1.3 Clove:

The clove, *Syzygium aromaticum* (L.) Merrill et. Perry, related to the family Myrtaceae. The clove is primarily harvested for its unopened flower buds, which are borne in clusters and dried to yield complete clove buds, i.e. the common spice. Ground clove and volatile oils are two other items made from clove. Clove buds, stems, and leaves, as well as oleoresins. Clove has a volatile oil

called eugenol (which has a high concentration of eugenol), acetyl eugenol, -caryophyllene, methyl salicylate, pinene, and vanillin (95%). The majority of cloves are used to make kretek (a type of clove cigarette). Only about 10% is used for other reasons in Indonesia, such as folklore. Medicine, food flavouring, food preservation, fragrance, and pharmaceuticals are all examples of industries that use fragrance. The Clove and clove oil usage is likely to increase [12].

2. MATERIALS AND METHODS:

2.1 Materials:

Guar gum (GG), Chitosan (CH), acetic acid, distilled water, cloves, nutrient agar, test organism (*E.coli*).

2.2 Methods:

2.2.1 Extraction of clove oil from clove buds:

The extraction was done as follows: In a flask of 100 ml distilled water, a specific amount of cloves were added and was allowed for 48 hours on normal stirring. After time duration, the clove buds was filtered out using filter paper and was kept in a brown glass bottle and was set aside in dark to avoid any potential light effect. The clove extract as CE.



Figure 1: Clove Extract

2.2.2 Preparation of guar gum and chitosan film:

GG (1%w/v) is liquefy in distilled water while CH (1%w/v) is dissolved in 1% (v/v) acetic acid . The polymer film is produced by casting method. The solution of GG and CH were homogenized and then poured to a petri

dish. The film is allowed to dry at 60° C in oven for 3 hours and then it was peeled off from petri dish. The film is made of different concentration, by taking the concentrated of GG (v/v)in film forming mixture is 50% (film A), 30% (film B) and 15% (film C) [21].



Figure 2: GG/CH composite film

2.2.3 Preparation of guar gum and chitosan composite film with clove extract:

A film forming solution was prepared by dissolving 1gm of guar gum (GG) in 100 ml distilled water and 1gm of chitosan (CH) in a

solution of 10ml acetic acid and 90 ml pure water. The guar gum and chitosan solution each 10ml is poured in petri dish and add 5ml clove extract into petri dish and dried at 60° for 6 hours and was peeled off.



Figure 3: Clove loaded GG/CH composite film

2.2.4 Antibacterial activity:

Anti bacterial of plant extract:

The zone of inhibition method is use of evaluate bacterial activity of each plant extract .Prepare nutrient agar with distilled water (100ml). Sterilize the media, tip, pipette, petriplate, corn Borer etc. After sterilization of media allow to room temperature and add 0.1 ml of test organism (*E.coli*). Mix it well and add it into aseptic petri dish, allow into solidify the plate. using Sterile Cork borer of 6mm diameter, four holes were made after add 100 ml of plant extract into each well incubate at 37° C for hours Next day observe zone of continence.

3. RESULT AND DISCUSSION:

3.1 FTIR analysis of composite film:

Fourier transform infrared spectroscopy (FT-IR) is a technique used to discover inorganic and organic components that could cause product contamination and malfunction. As a

result, FTIR is oftenly used to detect initial stage of any sample.

The FT-IR spectrum 500cm^{-1} was used to analyse this sample film using fourier transform infrared spectroscopy(FT-IR) (parul university).the scan has a resolution of 4 cm and were analysed in the range of 4000to 500cm^{-1} .the transmittance mode was used to record the FTIR spectra.

The film shows frequency as 3415.54 for NH_2 group, 1621.15 for COOH or O-H stretch, 1097.27 for C-H bond, 600.90 for C-H out of plane bending, 780.36 for C-H (1-band), 1565.36 for N-O stretch, 1419.62 for C=C stretch, 2926.37 for C-H stretch.

3.2 X-RAY DIFFRACTION (XRD):

It's a non-destructive technique which impart information about the structural parameter , phase, crystalline characteristics. XRD is rapid method, used for analyzing of unknown materials and minerals in a sample.

XRD was used to examine the properties of the GG / CH composite film. The diffraction of the XRD at various angles is depicted in the **Figure 5**. As demonstrated in the graph, the highest intensity of the diffracted X-ray was observed at 26° , as shown the graph.

3.3 Antibacterial properties:

The antibacterial activity test of film that contains clove extract was performed against *E.coli*. The result shows the presence of bioactive compound in extract of medicinal plant (**Figure 6**).

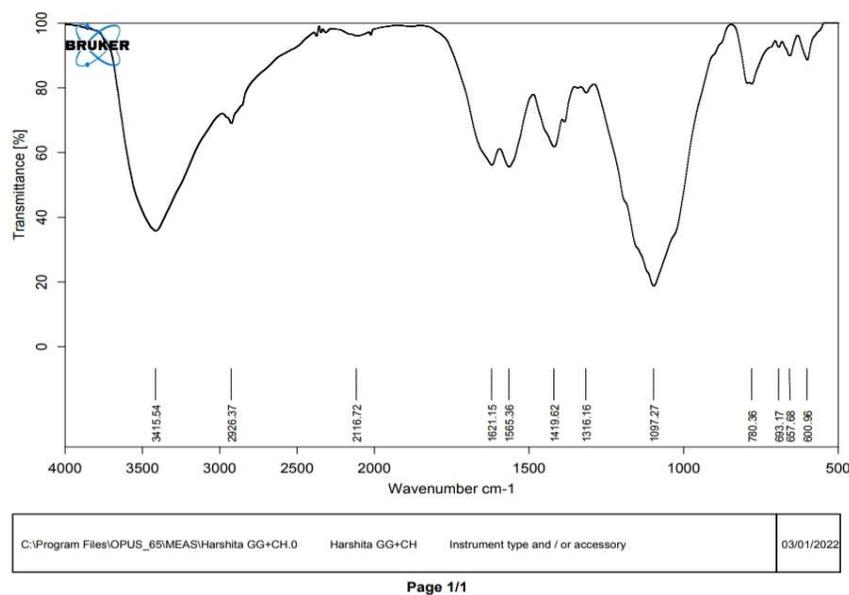


Figure 4: FTIR spectra of GG/CH composite film

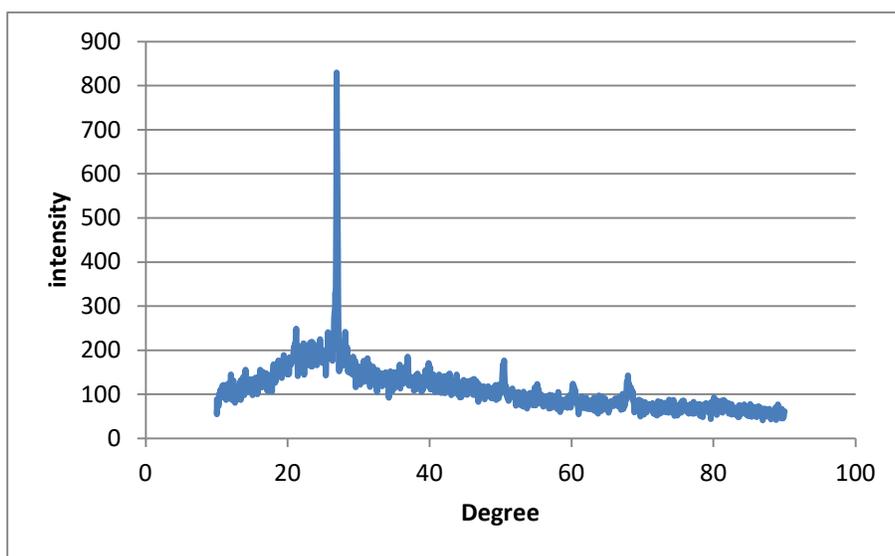


Figure 5: XRD spectra of GG/CH composite film

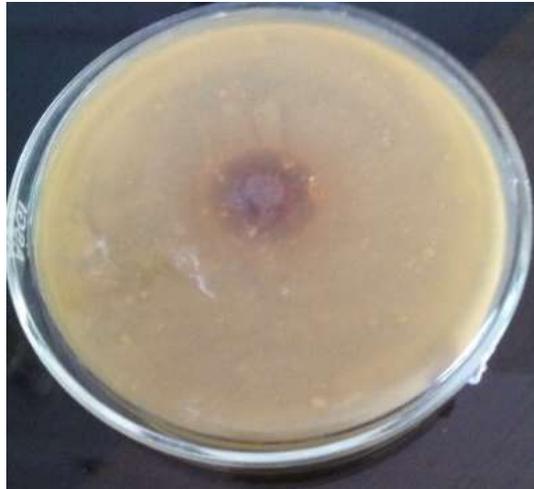


Figure 6: Antibacterial activity of clove loaded GG/CH film

4. CONCLUSION:

I have synthesized clove loaded guar gum/chitosan composite film, which is found good antibacterial activity against *E.coli*, and by FT-IR spectra we can find out GG/CH are present in composite film. I also performed a X-ray diffraction (XRD) for identify the type of material as well as its phase and crystalline properties.

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