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**ANTIBACTERIAL COMPOSITE FILM PREPARED FROM  
MICROCRYSTALLINE CELLULOSE-CHITOSAN FROM LIBR  
SOLUTION WITH GARLIC EXTRACTION**

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**ABSTRACT**

A film was prepared from chitosan-microcrystalline cellulose where added into lithium bromide (LiBr) solution. The microcrystalline cellulose -chitosan composite film where prepared from drying and wash by under uniform conditions. The garlic extraction was adding into the composite film. The antibacterial activity and mechanical properties of the composite film was increase due the extraction of garlic which shows more effective in composite film .The hydrogen bond between microcrystalline cellulose and chitosan in composite film was successfully achieved and maintained outstanding mechanical properties, according to the FT-IR results.

**Keywords:** Microcrystalline Cellulose, Chitosan, Garlic extraction, Glutaraldehyde, Antibacterial

**1. INTRODUCTION:**

Polymer is a natural or man-made compound composed of micro molecules, which are massive molecules that are multiples of monomers, which are smaller chemical units.

Polymer make up a number of materials in

living organism, including ,for example nucleic acids, proteins and cellulose Polymer can be found naturally in plants and animals (natural polymer) or man-made (man-made polymer) (synthetic polymer) [1]. Polymers

offer a variety of chemical and physical qualities that allow them to be used in everyday life. Packaging, agriculture, health, and other industries to make use as biodegradable materials [2].

Natural polymers such as chitosan, alginate, cellulose, collagen, hyaluronic acid, and gelatin have been used in wound dressing applications in the form of films, sponges, and fibres. Biodegradable polymer with environmental pollutant, and could be reduce as organic waste, thereby releasing carbon dioxide and water [3].

One of the most important therapeutic and economic challenges in medicine today is delayed wound healing. The skin, being the biggest organ, acts as a barrier against pathogen invasion of the human body; but, if wounded, it becomes highly vulnerable to bacterial infection. It has been reported that mortality in burn patients due to bacterial infection can reach up to 75%. As a result, wound dressing materials with infection, exudate removal, air permeability, and hemostasis are in great demand for the treatment of burn wounds [4].

### **1.1. MCC (micro crystalline cellulose):**

Microcrystalline cellulose is used in the food industry as a texturizer, anti-caking agent, fat substitute, extender, and bulking agent. Vitamin pills contain the most common type.

It's also used as a substitute for carboxymethyl cellulose for counting viruses. Microcrystalline cellulose is made from mainly depolymerized cellulose using the formula  $(C_6H_{10}O_5)_n$ . In plant cells, these linear cellulose strands are clustered together as microfibril spirals. Due to a high degree of three-dimensional internal bonding, some microfibrils have a crystalline form that is insoluble in water. However, this portion of the microfibril is comparatively weak, with lower internal connections, because microfibrils have a single-phase structure, crystalline spots are removed to make microcrystalline cellulose, and others believe that they should be called dislocations instead. (MMC) is a biodegradable film material that may replacing vegetal fibres [5].

### **1.2. CHITOSAN:**

Chitosan is a polysaccharide and it is made up of a different type of -(1-4)-linked D-glucosamine chains (deacetylated unit) and N-acetyl-D-glucosamine (N-acetyl-D-glucosamine). It's manufactured by treating the shrimp and other crustaceans' chitin shells with an alkaline material like sodium hydroxide and exoskeleton of insects. It is utilised in the medical field [6, 7].

Chitosan is claimed to cure High blood pressure, High cholesterol, Obesity, Wound healing, and Other illnesses, while many of

these claims are supported up but not as thoroughly as needed by scientific evidence. In the pharmaceutical industry, Chitosan is a substance used in tablets to enhance the way some drugs dissolve and hide nasty tastes. It is also used to increase shelf life of foods [7].

### 1.3. NATURAL PRODUCT

#### GARLIC

Garlic, one of the oldest plant used in medicine ranks the highest of all the herbal remedies consumed for its health benefits. Scientific and clinical studies have shown that garlic can enhance immunity, protect against infection and inflammation and help lower the risk of cancer, heart disease and dementia. Evidence supports the fact that regular consumption of garlic can reduced factor associated with cardiovascular disease

#### 2.2 preparation of the Microcrystalline Cellulose-Chitosan composite film

For the preparation, we used 1% microcrystalline and 1% chitosan, which were added to a 60% Libr solution and agitated at 600 rpm for 30 minutes. These solutions were heated for 30 minutes at 130°F. The complete dissolves after the microcrystalline cellulose and chitosan. The solutions were blended Garlic, one of the oldest medicinal plants, ranks first among all herbal medicines in terms of health benefits. Garlic is the herb that has been discussed the

most in the literature for its medical uses. Garlic has been confirmed in scientific and clinical research to boost immunity, defend against infection and inflammation, and help reduce the risk of cancer, heart disease, and dementia. Garlic eating on a regular basis has been shown to minimize factors linked to cardiovascular disease [8].

### 3. MATERIAL AND METHOD

#### 3.1 MATERIALS:

Microcrystalline cellulose and chitosan powders, as well as lithium bromide (libr), are used as microcrystalline cellulose and chitosan solvents, while glutaraldehyde is used as the solvent, Whatman filter paper.

Preparation of the microcrystalline cellulose-chitosan composite film:

For the preparation, we are using 1% of microcrystalline and 1% of chitosan where added into the 60% of Libr solution and stirred at 600 rpm for 30 minutes after that, these solution where heated at 130°at for 30 minutes. After the microcrystalline cellulose and chitosan where entire dissolve. The solutions were mixed in a 7:3 weight ratio of cellulose to chitosan and stirred for another 20minutes. The approach was to use a glass mould to make the same-sized gels. For one day, the solution was heated to 90 to 100 degrees Celsius. The temperature of the solution was set between 80 and 90 degrees Celsius.

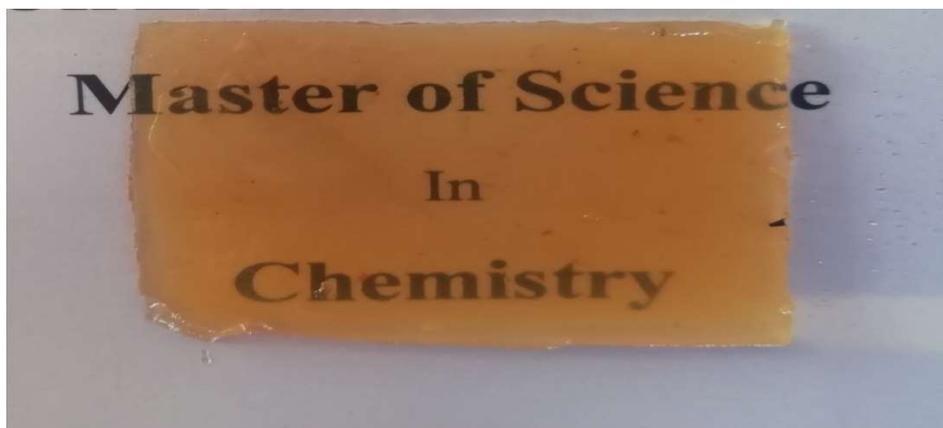


Figure 1: (composite film of CH/MCC with Libr)

### 3.3 EXTRACTION OF GARLIC

Garlic were purchased from the local market Gujarat. Garlic was washed with distilled water to minimize dust particles, then dried in the shade. The substance was grind into a fine powder using a grinder. In a 250 mL beaker, mix 5g powder with 20 mL methanol

and 80 mL water. The solution was boiled for 15 minutes until the aqueous solution was colourless. The mixture was subjected to cooling at room temperature and filtered with (whatman no.1). The extract was stored in refrigerator in order to be used for further experiments [9].

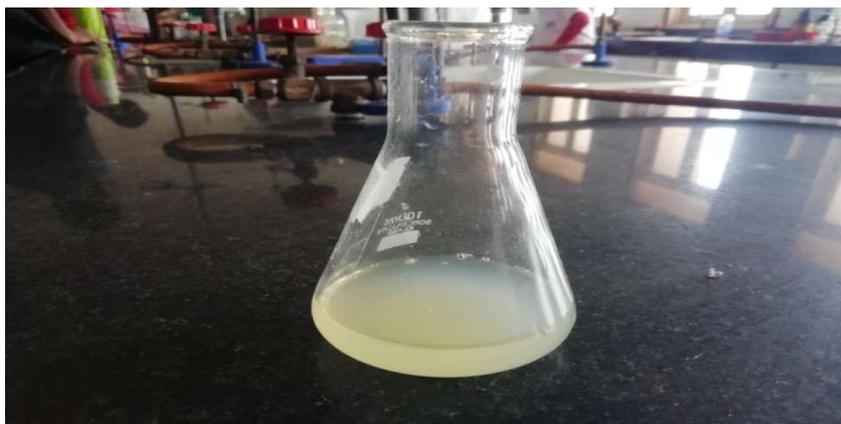


Figure: 2 (garlic extraction)

### 3.4. PREPARATION OF MICROCRYSTALLINE CELLULOSE – CHITASON -GARLIC EXTRACTION COMPOSITE FILM

For the preparation of garlic extraction composite film. Take 5 ml of garlic

extraction add mixed into the composite film of the cellulose\chitosan and crosslink with glutaraldehyde to blend and put in a dried hot air oven for one day.



Figure 3: (composite film of CH/MCC with garlic extraction)

#### 4. CHARACTERIZATION:

##### 4.1 FTIR ANALYSIS OF COMPOSITE FILM:

The identity of a functional group in a sample of CH/MCC composite film was verified using Fourier transform infrared (FTIR) spectroscopy. Film composed of 1% of each polymer solution were prepared by drying in oven for 24 h. each spectra is between 4000 to 500  $\text{cm}^{-1}$  [10, 11].

##### 4.2 SWELLING BEHAVIOUR:

In swelling behaviour we prepared three different type of film ratio of MCC/CH (1) the ratio of first film is (50:50), (2) the ratio of the second film is (70:30), (3) the ratio of third film is (60:40) the swelling behaviour of MCC/CH composite film changed into measure through immersing the sample in PF (NaCl and  $\text{CaCl}_2$ ) solution, the film was put in the PF solution for few hour [11].

##### 4.3 EXPANSION STUDY:

As previously mentioned, the expansion of wound dressing film on the wound was mimicked by measuring the change in

diameter of a circular film sample in a 10% gelatin solution. In a 100 mL distilled water, we dissolved 2 gram of gelatin powder. Heat the solution until all of the gelatin had dissolved in the water. Take 5ml of gelatin solution in petri plate and the film was put into the solution. On the gelatin surface, a film sample with a known diameter was inserted, and the diameter was measured. of the sample was changed on a regular basis until it achieved a consistent diameter [12].

The expansion ratio(ER) was expressed as

$$ER = \frac{\text{diameter at time (DT)}}{\text{initial diameter}(D_0)}$$

##### 4.4 X-Ray diffraction study:

One of the most common methods of XRD analysis is to identification of materials based on their diffraction pattern. In addition to phase identification, XRD offers information on how the real structure varies from the ideal one owing to internal stresses and defects.

X-rays are electromagnetic energy waves, whereas crystals are regular arrangements of atoms. When incident X-rays collide with the

electrons of crystal atoms, they disperse. The electron is the scatterer in this process known as elastic scattering. A regular array of scatterers is used to generate a regular array of spherical waves [13]. Due to destructive interference, these waves cancel each other out in most directions. Moreover, Bragg's law indicates that they add constructively in a few particular manner [14, 15].

#### 4.5 SEM ANALYSIS:

SEM (Scanning Electron Microscopy) is a test procedure that involves scanning a sample with an electron beam and analysing the enlarged picture. SEM analysis, often known as SEM microscopy, is a very effective technology for microanalysis and failure analysis of solid inorganic materials. High magnification electron microscopy generates high-resolution pictures and precisely quantifies very small features and objects.

#### 4.6 Antibacterial Activity:

In **Figure 9** shows how *E.coli* and pseudomonas were used to test the antibacterial activity of the MCC/CH film. The antibacterial activity of the mmc/ch composite film is investigated in relation to the manner of *E.coli* bacteria dissemination. In the antibacterial approach, we made a nutrient agar plate by dissolving 2.8 grams of

nutrient agar in 100 millilitres of distilled water in a flask. The flask was properly packed and placed in the autoclave. The culture plates were prepared by pouring 30 ml of sterilized nutrient agar allowed to solidify in autoclave. After solidification, bacteria was spread into the solidify agar solution and spread via a spreader. The composite film was cut and placed over agar plates, which were covered and sealed using paraffin and incubated at 37°C for 24. After incubation, the zone of inhibition was calculated [16].

### 5. RESULT AND DISCUSSION:

#### 5.1 FTIR ANALYSIS:

FTIR spectroscopy was used to analyse the chemical change in the film as the chitosan ratio changed. The composite film's FT-IR spectra are shown in **Figure (4)**. Chitosan's FT-IR spectra is similar to that of pure chitosan. A saccharide structure is shown by a peak at approx 586.09-1068.60 cm, the band at 551.81 is assigned to a stretching vibration of C-Br of glutaraldehyde and 1068.60 is assigned to a vibration stretching bending of ether group CH<sub>2</sub>-O-CH<sub>2</sub> of cellulose. The band at 1632.49 was caused by the NH bending of the amine group of chitosan. The band at 2078.66 is formed by the stretching vibration of the OH group.

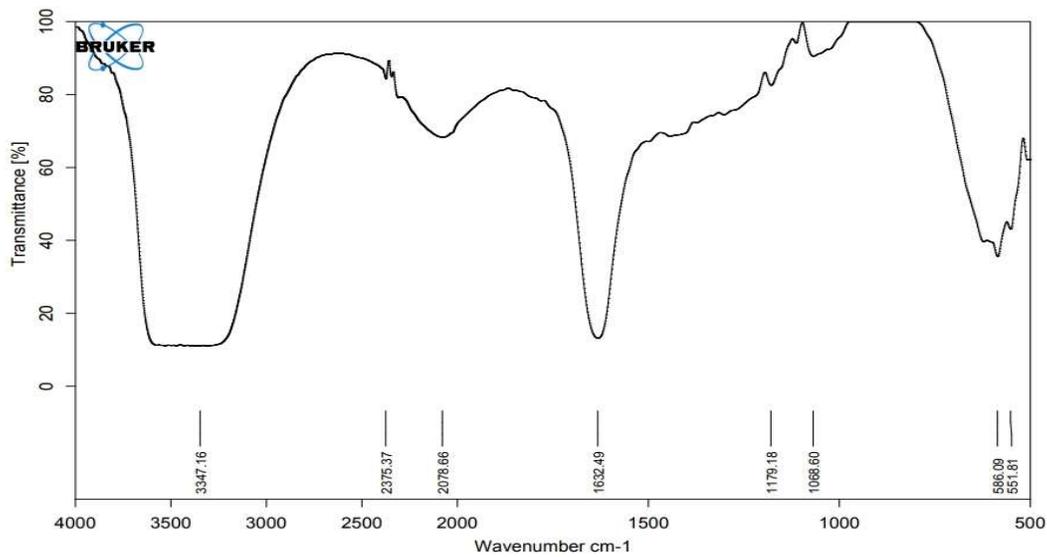


Figure 4: (FTIR spectrum of ch/mcc film)

**5.2 Swelling result:**

The degree of swelling determines how long the composite film can be kept wet.. The swelling percentage of CH/MCC film treated with pf solution of CaCl<sub>2</sub> and NaCl solution and immerision for time period were recorded. The results reveal that the swelling degree of the polymer film rises throughout a

30-minute period. The swelling was increases for a few hour but at a certain time 3h it will stop swelling the pf solution.

Table 1

Time	SR =((Mt-M0))/M0		
	ch/mcc 50/50	ch/mcc 60/40	ch/mcc 70/30
0	1	1	1
30	1.3	1.2	1.3
60	1.6	1.5	1.5
120	1.7	1.6	1.7
150	1.9	1.9	1.8
180	2	1.9	1.8
210	2	1.9	1.8

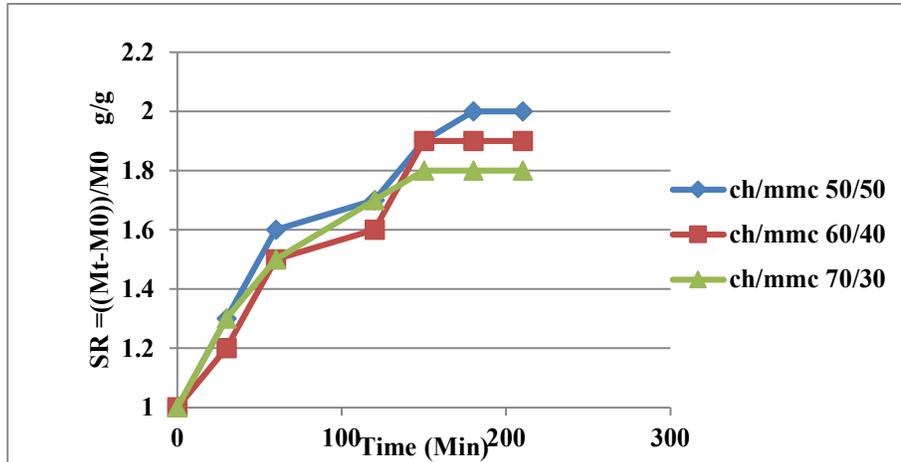


Figure 5: swelling graph (SR) versus time plots for the samples of ch/mcc(50/50),ch/mcc(60/40),ch/mcc(70/30)

**5.3 Expansion result:**

To simulate a supportive wound, a gelatin solution is employed. The investigation of a film's expansion behaviour on the surface of

gelatin medium gives important information about the film's appropriateness in wounds with a lot of exudate.

Time	SR = ((Mt-M0))/M0		
	ch/mcc 50/50	ch/mcc 60/40	ch/mcc 70/30
0	1	1	1
30	1.3	1.2	1.3
60	1.6	1.5	1.5
120	1.7	1.6	1.7
150	1.9	1.9	1.8
180	2	1.9	1.8
210	2	1.9	1.8

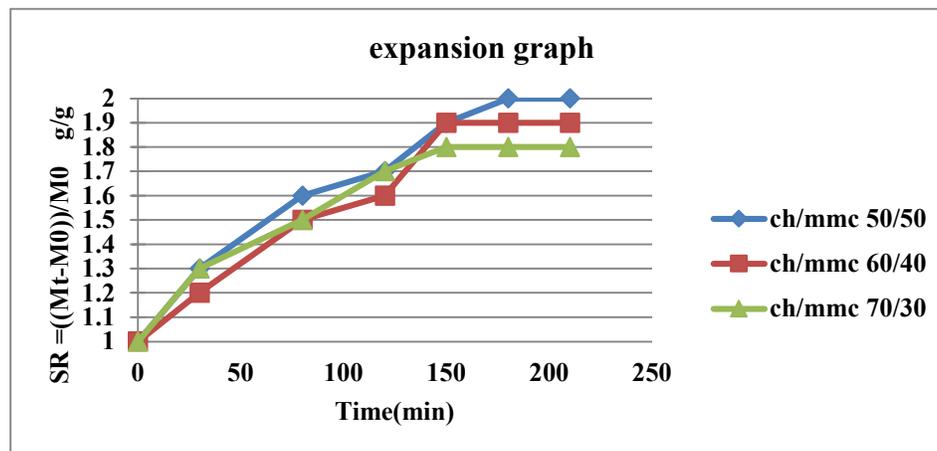


Figure 6: Expansion ratio (ER) versus time plots for the samples of ch/mcc (50/50),ch/mcc(60/40),ch/mcc(70/30)

#### 5.4 X-ray diffraction analysis:

It was used for the characterization of the CH/MMC with garlic extraction composite film. the diffraction at various angles for the

XRD is shown in **Figure 7**. As can be seen in the chart the maximum intensity of the diffracted X-ray was observed at  $31^{\circ}5$ .

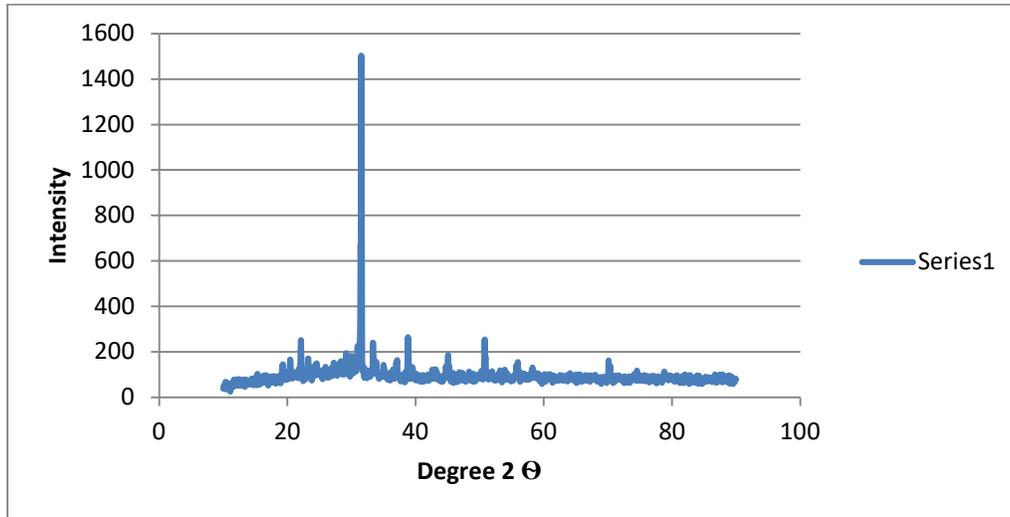


Figure 7: x-ray diffraction of chitosan/cellulose

#### 5.5 SEM Analysis:

SEM (Scanning Electron Microscopy) is a test procedure that involves scanning a

sample with an electron beam and studying the enhanced picture.

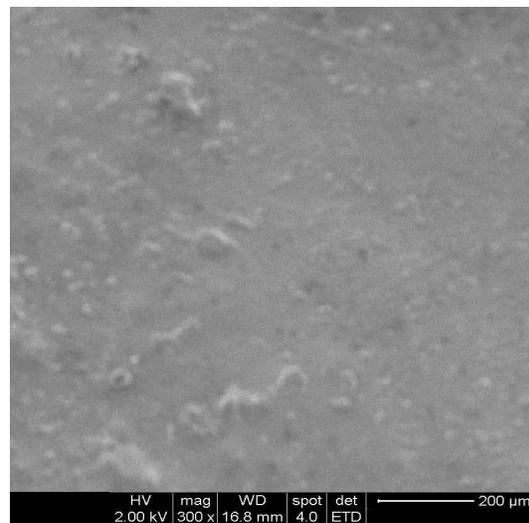
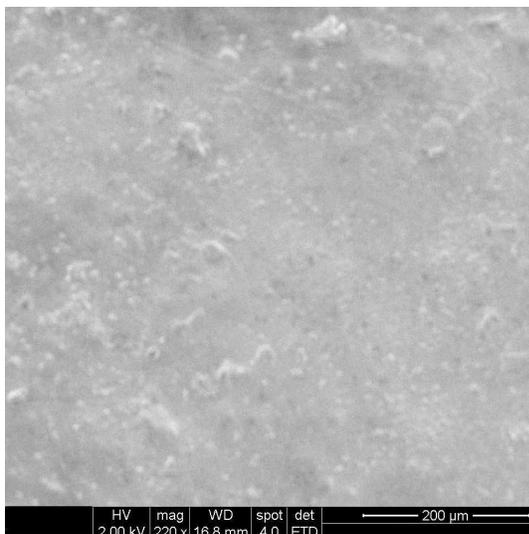


Figure 8: SEM image A Chitosan film and B-composite film

### 5.6 Antibacterial activity:

The typical antibacterial test result of the film using disc technique is shown in **Figure 9**. The antibacterial activity of the MCC/CH film was tested using *E.coli* and

*pseudomonas bacteria*. It was found that the garlic extraction loaded film demonstrated inhibition zones nearly 12 mm for *E.coli* and *pseudomonas bacteria*.



Figure 9: Antibacterial activity of composite film

### 6. CONCLUSION:

I have synthesis Garlic extract loaded MCC/CH composite film which found very good antibacterial activity again *E.coli*, and *Pseudomonas* by FTIR spectra we can find out MCC/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. In this research, I also conclude Swelling test, SEM analysis, and expansion study.

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