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MAGNESIUM OXIDE NANO-PARTICLES & AMOXICILLIN INCORPORATED POLY-VINYL ALCOHOL/CARBOXYL METHYLCELLULOSE COMPOSITE FILM FOR ANTI-BACTERIAL ACTIVITY

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ABSTRACT

In this work Carboxyl Methyl Cellulose (CMC)/Copolymer Poly (Vinyl Alcohol) (PVA)/ Magnesium-Oxide (Mgo) nanoparticle is used to perform antibacterial activity. PVA/CMC films are made with varying polymer ratios and is linked to glutaraldehyde and amoxicillin. The polymer film is shown using techniques such as Fourier transform infrared spectroscopy (FTIR), Nano-sizer test, X-ray diffraction (XRD). The composite film was reviewed by Water sorption, swelling behaviour. Finally, the antimicrobial activity of this CMC / PVA / MgO Nano-composite has been tested against bacteria.

Keywords: Carboxymethylcellulose; Polyvinyl-alcohol; 1%glutaraldehyde; MgO Nano-particle; Amoxicillin

INTRODUCTION

Currently, nano-technology is the field of future research in Modern Material Science. Nano-particles are rich in both improved and new properties based on its distinct characteristics **[1]**. Characteristics like, Morphology, Distribution, and Size. Most important are the novel and size, textures, and in this manner, nanotechnology gives a way to enhance the interest of the inorganic anti-bacterial agent. Metal oxide nano particles including Cao, MgO, ZnO, etc. were studied as the inorganic Anti-bacterial retailers **[2]**. the main gain of inorganic antibacterial marketers is their right balance at high temperatures, stress, and toughness. Out of numerous inorganic metal oxides, MgO particles as an anti-bacterial agent have the

superiority of being non-toxic, comparatively, it's easy availability and secure materials as it is FDA approved **[3]**.

The MgO nanoparticle has also shown significant efficacy against *Staphylococcus aureus* and *Escherichia Coli bacteria* **[4]**. Antibacterial activity of MgO nanoparticle relies upon the particle size and quantity. Because of the excessive electrostatic contact between the positive Charges and the negative price of bacteria, harm **[5]**.

Contamination of bacteria attracts public attention. There has been nearly 48 million cases of infections and diseases in the U.S. Therefore, it's miles essential to increase powerful anti-bacteria l agents to manipulate the bacterial population **[6]**.

MgO nanoparticle has antibacterial properties and it's far used in many packages which include Catalysis, catalyst assist, anti-corrosive solvents and adsorbents, heavy oil components, show, and Anti reflecting coating, superconducting and ferroelectric **[7]**. Electrical protective equipment for the crucible, smelter, insulated conduit (tubular section), electrode bar.

In the work, a composite film from PVA/CMC and MgO nanoparticle with a small amount of amoxicillin composite film was designed by their valuable properties in platform evaluated their appropriate Antibacterial activities.

MATERIALS AND METHODS

Preparation of CMC/PVA blend film

The adhesive film solution was prepared by dissolving 1 gm of melted PVA powder in 19.6ml. Then 0.4g CMC powder was dissolving in hot distilled water on stirring 60c for 3hr.finally, a Homogenous Solution of CMC/PVA was prepared with different polymer ratios (70:30 CMC/PVA,50:50 CMC/PVA,30:70 CMC/PVA) at dried at 40c. The obtained PVA/CMC film was crosslinked by adding 25% glutaraldehyde Solution used in 1 ml each of blend Film and Finally dried in a hot oven **[8]**.

Synthesis of MgO nano-particle

MgO-nanoparticles prepare via co-precipitation Method in Parul University Laboratory was used. 0.5M Solution of NaOH and $MgCl_2$ were prepared by dissolving in distilled water. NAOH Solution added in $MgCl_2$ Solution dropwise and stirring for result white Colour precipitate of $Mg(Oh)_2$ was formed **[9]**.

The solution was Filtrate by what-man filter paper and the rain washes water several times with ethanol. precipitation was dried at room temperature for 2hr after being placed in a hot oven of $40C_{in}$ 3hr and Calculated in a Muffle furnace at 350c 2hr. 250nm to 600nm the size of MgO nanoparticles was formed **[10]**.

Preparation of MgO-nanoparticle/ CMC/ PVA/ Amoxicillin Composite Film

Prepare MgO nanoparticles and a small amount of amoxicillin was mixed with CMC/PVA Film crosslinked by glutaraldehyde to the blend and finally dried in a hot air oven.

Characterization of the prepared film

Fourier transform infrared (FTIR) analysis

Samples were reduced inside the square with a 1cm to1.5cm radius. Fourier transform infrared (FTIR) spectra (transmission) had been received in a Perkin-Elmer FTIR spectrophotometer in the frequency variety of 4000–500cm-1 with 4cm-1 resolution

Swelling studies

The water absorption behaviours of hydrogel samples become gravimetrically decided as also studies in our previous researches **[11]**. In quick 250L PF (Physiological Fluid) that is, a pH 7.4 phosphate buffer is taken in a beaker on 370C in an incubator, and the pre-weighted piece of dry hydrogel sample becomes located. The pattern changes were taken on ordinary time durations, they were then superficially wiped using a tissue paper to dispose of greater floor water, the samples were then weighed on an electric balance (Denber, Germany), after which positioned back inside swelling medium. Mass measurements had been endured until a constant weight is attained. For hydrogels the SR (swelling ratio) become decided using the subsequent expression:

$$Swelling\ Ratio\ (SR) = \frac{(w_t - w_o)}{W_O}\frac{g}{g}$$

in which, W_o load of dry gel and W_t is load of swollen gel. To calculate the swelling ratio equilibrium, wt turned into changed by using We in the above expression, where We are the hydrogel mass at equilibrium.

Moisture retention ability

Composite Film samples were cut into equal size s and the preliminary weight of each pattern was stated as W1. The Film had been put inside the Hot air oven at 40°C. After nine h, the educated sample's burden turned into measured and recorded as W2.

The moisture retention capacity became calculated through the following equation **[12]**.

$$Moisture\ retention\ ability\ (\%) = (W2 \div W1) \times 100\%$$

X-ray diffractometer Study

The X-ray diffractometer became used for segment identification. The samples were powder formatted and used film exposed to an X-ray. The patter was recorded at 45kV and 40mA in the 2θ range of 5º-60º for a film**.**

Nano sizer Analysis

The Nano sizer or zeta sizer was measured graph of intensity% vs size it gives the relationship between size and intensity. It

gives results of size distribution by intensity.

Antimicrobial activity

MgO/amoxicillin contain CMC/PVA Prepared composite films were exhibited antimicrobial activity against, S. aureus and E. coli (received from Parul University, Baroda, India) Bacteria grow in an incubator for 24 h at 37°C. Prepared composite polymer film samples with 0.2 cm diameter were transferred aseptically and plated on plate nutrient agar. The antimicrobial property of CMC/PVA/MgO/amoxicillin composites turns into studied against the E. coli bacteria spreading method. A nutrient Agar plat is formed by mixing 2.8g nutrient agar in 100ml distilled water in a flask and the flask was completely packed and put in the autoclave. The culture plates were prepared by pouring 30 ml of sterilized nutrient agar and allowed to solidify in Autoclave. After solidification, bacterial strains were poured into separate plates and spread via a spreader. The composite film was cut were placed over agar plates, which were covered and sealed using paraffin and incubated at 37°C for 24 to 48h. After incubation, the region of inhibition was calculated. Smaller reduced paper to dip in PVA/CMC solution brings MgO nanoparticle with small quantity amoxicillin power used as an advanced antimicrobial asset. They reduced paper turned into located over agar plates, which were covered and sealed with the usage of paraffin and incubated on 37°C for 24 to 48h. After this the area of inhibition changed into calculated.

RESULTS AND DISCUSSION

Preparation of CMC/PVA films

Preparation of CMC/PVA film at distinct volume ratios of 30:70(CMC.PVA), 50:50(CMC/PVA/MgO-nps), and 70:30(CMC/PVA) were and the films were then crosslinked with glutaraldehyde to make them stiffer and chemically stable. **Figure 1** depicts the prepared films.

Fourier transform infrared spectroscopy (FTIR) analysis

In FTIR spectra formed with PVA/CMC/MgO films **(Figure A)**, a broad and robust band at 3600–3000 cm−1 corresponds to OH stretching (region1), which indicates the presence of both strong hydrogens bonding internally to OH or terminal vinyl group and OH stretch of CMC. Band formed on 2915 cm−1 is because of stretching in C-H group (region 2). However, the carbonyl (C = O) The peak at 1800–1500 cm−1 (region 3), ether peak at 1046 cm−1 and –CH2 peak on 1414 cm−1, (region 4) confirmed the inclusion of – OCH2COO group into the cellulose molecule **[13, 14]**. In crosslinked films **(Figure 2)**, a broad and robust band at 3600–3000cm−1 which matches with OH stretching of both CMC and PVA. The

carbonyl (C = O) peak at 1800– 1500 cm−1, a CH2 peak at 1500–1300 cm−1 are also observed.

Nano sizer Analysis

The zeta potential of Magnesium oxide nanoparticles was measured around 279.6d nm which is reported present in the figure. sample vehicle was water. The sample was analysis were in PIPH in Parul University.

Swelling studies

The swelling studies of the composite movie were decided by way of measured swelling percentage (%) of the pattern from the parent it can be shown in **Figure 4** PVA/CMC/MgO first 20 min swelling rapid and weight was occurred increased. during the first 20 (min) PVA/CMC (30:70) showed comparatively low swelling and minimum weight increased. after 1hr degradation of the film started.

Antimicrobial activity

The antimicrobial property of PVA/CMC/MgO and PVA/CMC composite was studied against *E. coli Bacteria*. in figure a sample without MgO and low contain MgO did not show any antimicrobial activity. The antimicrobial activity shows the presence of high contains MgO. In figure b high contain MgO therefor Zone of inhibition represents the antimicrobial activity of the prepared composite film in **Figure 5b**.

X-ray diffractometer Study

(a) (b) (c)

Figure 1: a: 50:50 CMC/PVA/MgO; b: 70%PVA+30CMC+glutraldehydeL c: 30%PVA+70%CMC+glutraldehyde

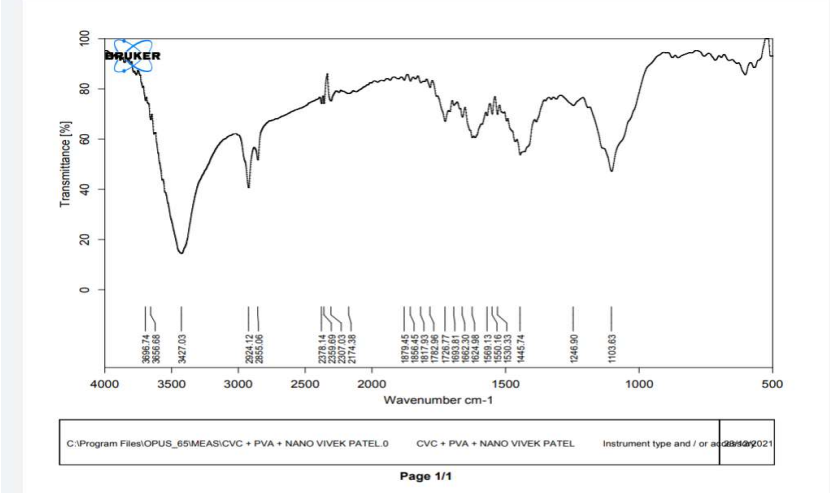

Figure 2: (PVA/CMC/MgO-FTIR)

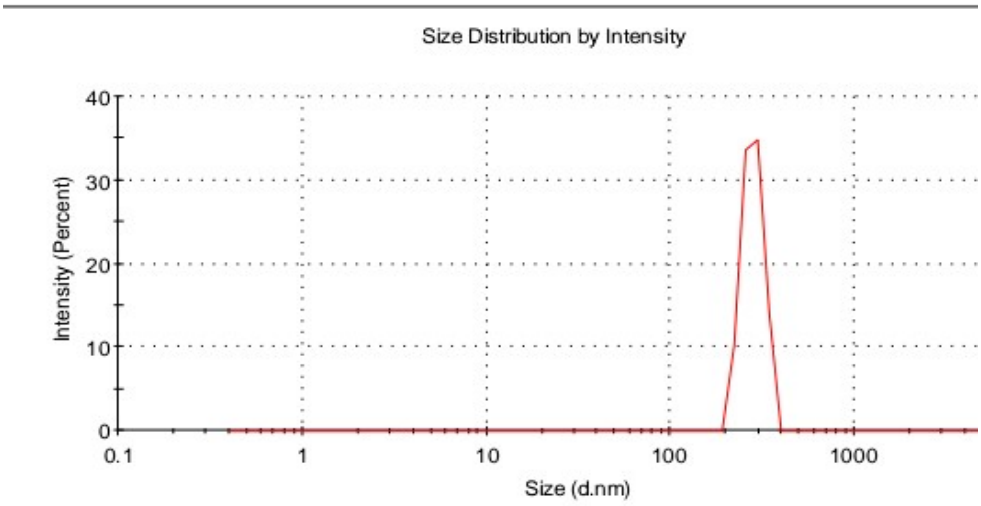

Figure 3: MgO particle size

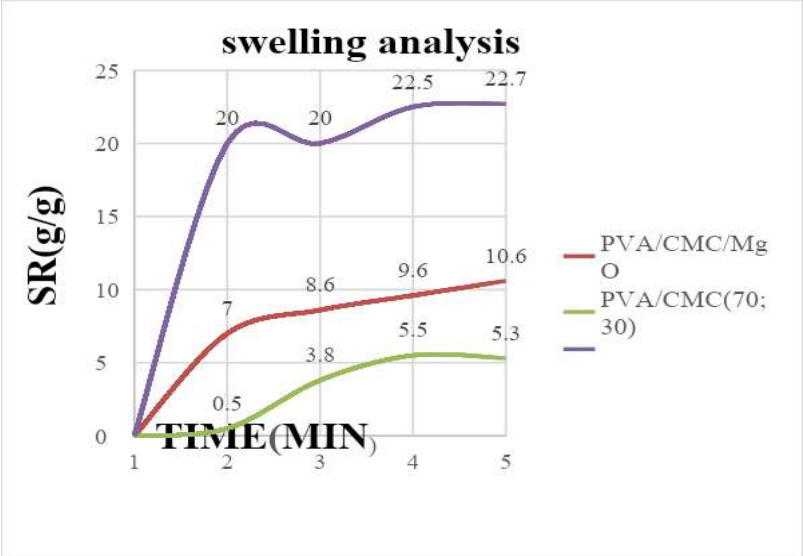

Figure 4: Swelling studies ratio

Figure 5: Antimicrobial activity
(a)PVA/CMC Without MgO (b) PVA/CMC with MgO and Amoxicillin

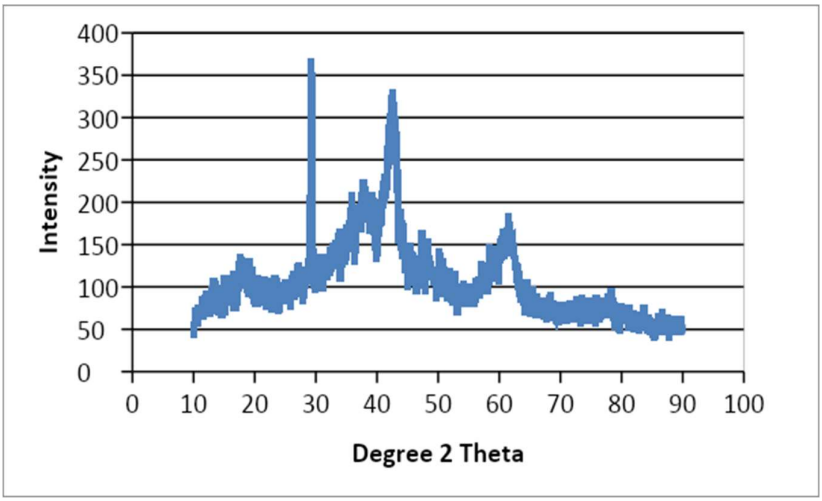

Figure 6: X-ray diffractometer study graph

CONCLUSION

Within the work, CMC/PVA films were prepared and characterized maintaining in view. Based totally on diverse characterizations executed, CMC/PVA (50:50) became located be the most favourable composition as its tensile strength each condition dry and moist, and was discovered to be close to that of human skin. Besides, the film roughness is favourable for swelling and cell adhesion and shows a controlled rate pf degradation. The antimicrobial belongings became tested PVA/ CMC (50:50) by the addition of MgO nanoparticles inside the polymer film. Furthermore, the addition of MgO in CMC/PVA films increased cell viability.

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