

# Fabricating and Evaluating the Antibacterial Susceptibility of Nanofibers Sheet Incorporated with Ceftriaxone

Youdhestar<sup>1</sup>, Farooq Ahmed<sup>2</sup>, Ayesha Tajammul<sup>3</sup>, Zeeshan Khatri<sup>2</sup>, Mohan<sup>4</sup>, Muzamil Khatri<sup>5</sup>

<sup>1</sup>*Institute of Environmental Engineering and Management, Mehran-UET, Jamshoro, Pakistan*

<sup>2</sup>*Center of Excellence in Nanotechnology and Materials, Mehran UET, Jamshoro, Pakistan*

<sup>3</sup>*Department of Water Sanitation and Health Sciences, (USPCAS-W), Mehran UET, Jamshoro, Pakistan*

<sup>4</sup>*Education and Literacy Department Government of Sindh, Boys High School Khahi, Taluka Khipro, District Sanghar, Pakistan*

<sup>5</sup>*Nano Fusion Technology Research Lab, Division of Frontier Fibers, Institute for Fiber Engineering (IFES), Interdisciplinary Cluster of Cutting Edge Research (ICCER), Shishu University, Japan*

**Abstract:** In this study, evaluating the antimicrobial susceptibility of nanofibers sheets, the ceftriaxone 3rd generation of cephalosporin was used to incorporate with polyvinyl alcohol (PVA) with different percentages (0%, 5%, 10%, 15%, and 20%) of polymer weight for the production of nanofibers sheets. For the evaluating the antimicrobial susceptibility, microbes were used *Escherichia coli* (E.coli) which were represent gram-negative bacteria. After the production of nanofibers sheets the characterization of sheets were done which includes Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD) and scanning electron microscopy (SEM). The Kirby–Bauer test (disc diffusion test) was used to evaluate the antimicrobial susceptibility of nanofibers sheets. The result shows the comparably good on microbes the inhibition zone ranges 20-25mm against E.coli.

**Keywords:** Evaluating, Susceptibility, Ceftriaxone, Antibacterial, PVA, FTIR, XRD, Nanofibers

## I. INTRODUCTION

The global cause of mortality and morbidity are infectious diseases. Bacteria are the main cause of infectious diseases which create condition of death or upto death. From the prevention of bacteria many researchers work to get solution for the problem the nanotechnology put great concerns due to its versatility in processes and applications. Electrospinning is a technique which is used to produce nanofibers which have high surface area then the volume it form thin films/ sheets, have pores in structure it has many applications such as tissue engineering, scaffolding, biomedical and drug delivery system. Poly vinyl alcohol is a synthetic biopolymer which is dissolve in water, having properties such that, biocompatibility, biodegradability, and has applications in biomedical and in drug delivery systems.

Ceftriaxone was used to treat a broad range of bacterial infections. This drug belongs to a class of drugs called cephalosporins. This prevents bacterial growth.

## II. MATERIAL AND METHODS

### 2.1 Materials

Polyvinyl alcohol polymer (Mw 89,000-98,000) was purchased from Sigma Aldrich (USA), used without further purification ceftriaxone was obtained from Macter international limited Karachi.

### 2.2 Methods

#### 2.2.1 Electrospinning

Electrospinning was technique which is used to produce nanofibers which have high surface area then the volume it form thin films/ sheets, in this research PVA was used to form nanofibers sheets

#### 2.2.2 Preparation of PVA Solution

The 10% PVA solution was ready by magnetic stirring at room temperature using water as a solvent, after the complete dissolve of PVA then different concentration of ceftriaxone (5%, 10%, 15%, 20%) by polymer weight are added and then again stirrer for 30 minutes for formation of homogeneous solution. The solution was equipped with a 5ml syringe connected with a capillary tip. The copper wire was connected to a positive electrode (anode), which was put into PVA solution, and the negative electrode (cathode) was connected to the ground collector. The distance between the needle and the collector was 10 cm and a direct voltage of 16 kV was applied between the needle and the collector.

### 2.3 Antimicrobial Agent

Ceftriaxone was used to treat a broad range of bacterial infections. This drug belongs to a class of drugs called cephalosporins. This prevents bacterial growth. Ceftriaxone used as antimicrobial agent purchased from macter international limited.

## 2.4 Evaluation of antimicrobial activity

### 2.4.1 Preparation of agar

Eosin methylene blue (EMB) agar 37.5 g/L was dissolved in distilled water and heating up to boiling then pour into petri plate up to 100-150 mm then leave up to 15 minutes for solidifying the agar.

### 2.4.2 Antibacterial Test

The medium used for the Kirby Bauer test (disc dispersion test) was an EMB agar that was only 4 mm deep and must be poured into a Petri plate with 100 mm or 150 mm. Remove some organisms from culture with sterile cotton swab and rub them on EMB agar plates to create bacterial turf. For uniform growth, splash the cotton bush in one direction, twist the plate at 90° and then splash in that direction. Repeat this rotation three times to allow the plate to dry for about 5 minutes.

Use an antibiotic disc dispenser to place discs on the agar plate with specific antibiotics. Use flame for sterilizing the forceps, and press the disc on the agar plate and make sure that disc gently attached with the plate. Plates leave in incubator overnight for incubation at 37 °C, and then note the results.

## III. RESULT AND DISCUSSION

### 3.1 Morphological evaluation of nanofibers sheets incorporated with drug

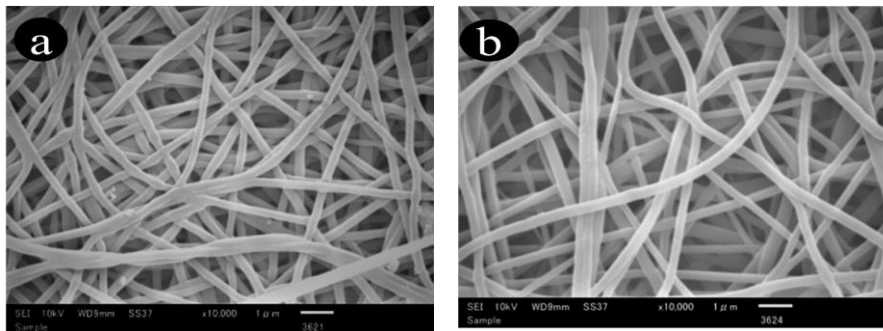


Fig 1: SEM images of PVA nanofibers (a) Neat (b) Incorporated with drug

SEM images of neat PVA nanofibers and after the incorporation of drug shows that there is no change in surface morphology, the fibers are even and having average diameter of 300-500nm.

### 3.2 Characterization of nanofibers

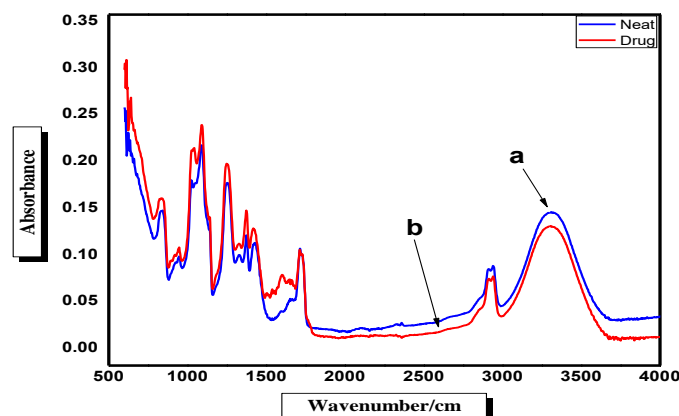


Fig 2: FTIR spectrum of PVA (a) Neat (b) Incorporated with drug

The spectrum shows the bands at 1148 cm<sup>-1</sup>, 2925 cm<sup>-1</sup>, 2960 cm<sup>-1</sup>. At 1148 cm<sup>-1</sup> show -OH group, 2925 cm<sup>-1</sup> indicate the -CH<sub>2</sub>- peak and 2960 cm<sup>-1</sup> show -CH<sub>3</sub> stretching. A very wide frequency band at 3480 cm<sup>-1</sup> shows the presence of water absorbed by the PVA molecular chains.

### 3.3 XRD Spectra

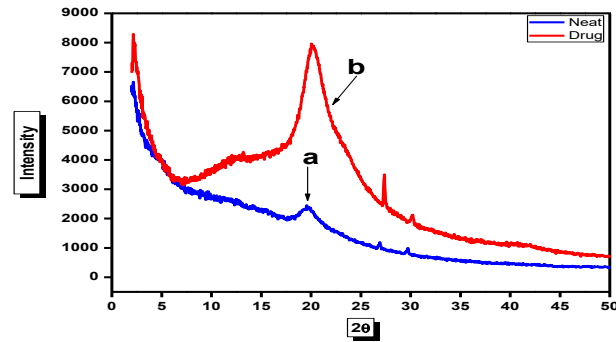


Fig 3: XRD spectra of PVA (a) Neat and (b) Incorporated with drug

X-ray Diffraction describe the PVA nanofibers is crystalline and amorphous in nature. In order to study the crystallinity of PVA nanofibers as shown in figure 3. The observed peak at  $2\theta = 30$  and  $20$ . The crystalline region makes it highly oriented and the non-crystalline regions provide the important properties of high stretchability. Low numbers of peaks shows that the PVA is not in crystalline in nature.

### 3.4 Effect of PVA incorporated with drug on *E.Coli*

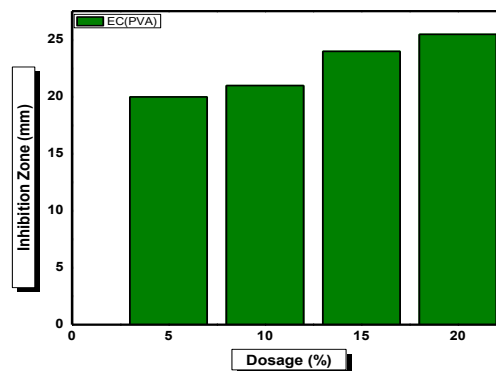


Fig 4: Effect of PVA incorporated with drug on *E.Coli*

The graph shows that the inhibition zone or bacterial susceptibility increased when the drug concentration increased, the graph shows 20% of polymer weight of drug is incorporated the inhibition zone increased up to 24mm at *E.coli* and 21.5mm at *S.aureus*.

## IV. CONCLUSION

It was found from our study that polyvinyl alcohol incorporated with ceftriaxone has inhibition zone against *E.coli* (24mm). FTIR results of PVA neat nanofibers and after incorporation of ceftriaxone show that there is no chemical change in nanofibers.

SEM images of neat PVA nanofibers and after incorporation of ceftriaxone show there is no beads are present in it and diameter ranges 300-500 nm.

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