MINERAL COATED WOUND DRESSING FOR HEMOSTASIS

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ABSTRACT :

Haemorrhage in trauma accounts for 30–40% of all fatalities as a cause of death.Wound dressings of biominerals are biocompatible, biodegradable, haemostatic and antibacterial biomaterials. This field studies on how the mineral particles and textile structures together could be used to design advanced medical products for applications outside human body. Montmorillonite is one of mineral particle from soil clay. It has high cationic exchange capacity. These negatively charged ions are rather loosely held and can readily be exchanged for others in a contact solution Along with the minerals, Nano particles are deposited over a nano film and studies are taken. Hence in way of producing nano particles through textile processed wound dressing can possibility of good efficacy so electro spinning technology is used to produce nano film for efficient drug release. The proposed system of wound dressing production in electrospinning is by nano film through various combinations and conditions. Due to their nano particle size in electro spun material had advantage on blood clotting is due to superior cationic exchange property while reacting with blood cells results to faster blood clot with reduced pain in healing. Hence the property where studied by comparing nanofilm and coating with powder form and normal dressing. Blood clot evaluations are analyzed through blood clotting and bleeding time test. In actual bleeding time of normal acute wounds take 240 sec to clot formation hence in our nano film performs clot formation within 40 sec under standard testing conditions. Bio compatibility test is analyzed to compatibility with blood cells of human being through in vitro studies by evaluation by rat cells.

1. INTRODUCTION:

Wound dressings and devices form an important segment of the medical and pharmaceutical wound care market worldwide. In the past, traditional dressings such as natural or synthetic bandages, cotton wool, lint and gauzes all with varying degrees of absorbency were used for the management of wounds. Electro spinning is a renowned technique for generation polymeric nano fibres that has a very large surface area to volume ratio. Nano fibres obtained from Electrospinning have diverse application scaffolds, bio materials and drug delivery systems. However, chitosan is not easily electrospun, perhaps due to its polyelectrolyte nature and intrinsically high viscosity. Hence chitosan alone is quite expensive and the film properties are quite delicate. To overcome such drawbacks, previous researchers formed films with sufficient physical strength from polymer and chitosan solutions using polyvinyl alcohol. PVA-Chitosan blend films with 70/30 ratios were prepared by dissolving the polymers. Chitosan nanofibres can be obtained by dissolving chitosan in acetic acid. In this study, The chitosan derivatives namely PVA / chitosan have been developed and then electrospun using different spinning parameters to produce fibre for their application in wound dressings.

2. MATERIALS AND METHODS:

2.1 Preparation of Electrospinning Solutions:

The solvent used to form electrospinning solution was polyvinyl alcohol. The required quantity of polyvinyl alcohol and chitosan solution were taken into a bottle and desired amount based on required concentration. Hence 70 % of polyvinyl alcohol and 30% chitosan solution were taken. Then the solution was stirred. The bottle was closed using an airtight lid and then placed in the bath. The solution was left overnight and then used for electrospinning. During left the solution it was settle down and form some viscous ability to electro spinning with low wastage in solution.

2.2 Electrospinning:

The electrospinning equipment used consists of an extrusion system (syringe pump), fibre collection system, and high voltage power supply. The extrusion system was used to provide controlled feed rate of the spinning solution. The polymer solution was given a positive field with the help of a high voltage power supply. The terminal wire (positive electrode) from the high voltage power supply was fixed to the extrusion needle (1 mm inner diameter). The system of collection of fibres includes a drum. A strip of 10 cm wide viscose nonwoven was mounted securely around the fibre collecting drum. Gauze of the same width was mounted over the viscose nonwoven.

2.3 Preparation of Coating Solution:

The chitosan was prepared by first dissolving chitosan in acetic acid to yield 1% aqueous acetic acid solution. Then the solution was stirred for 120mins at 60 degree celsius temperature. Then Montmorillonite solution is prepared by mixing powder form in acetic acid. Dissolving Montmorillonite in 1 % aqueous acetic acid solution then it is stirred for 160 mins at 60 degree Celsius temperature. Both the solution are prepared separately and combining that in proper proportion for coating solution. Combination of chitosan and montmorillonite is taken in three forms they are 50/50, 60/40, 70/30 respectively. These solutions are taken for the coating layer on nano film as we prepared in electrospinning.

2.4 Spray Coating:

Prepared solution are taken in beaker and measured. There is three various of deposition made on the film they are based on the weight by weight criteria. On weight of nano film 5%, 10%, and 15% are taken as various parameters coated on chitosan/PVA blended nano film in three combinations made during solution preparation. At the first empty base material is weighed and after electrospinning again its weighed. The weight difference is the total volume of nano film. In spray coating machine amount of coating solution were taken on film weight basis. Each 10 ml of combined solution contained 0.1 gm of chitosan and montmorillonite. Hence film weight is ranged in 3 gm. The solutions were taken as in content of 6ml, 12ml and 24ml. it is sprayed under normal pressure with 0.1mm dia nozzle. Then it is dried under normal room temperature without ant temperature application.

3. RESULTS AND DISCUSSION

3.1 Electrospinning of Blended Solution 70/30 PVA/Chitosan

PVA was used for blending with chitosan solution to provide spinnability of blended solution and to get better mechanical properties of the fibre. Figure shows SEM photographs of nanofibre web that was obtained from the blended solution of chitosan and PVA. At ratio of 70:30 (PVA/chitosan), The viscosity of the blended solution is one of the perceived parameters that affects the structure and diameter of the fibre. The average diameter of the fibre is found to be 113.6 nm.

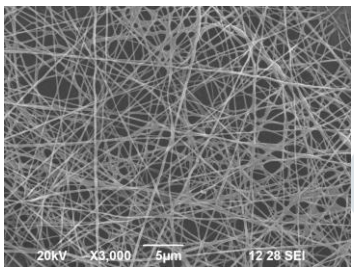

Fig : 1 – SEM (x 3000)

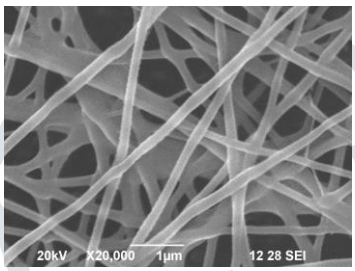

Fig : 2 - SEM (x 20,000)

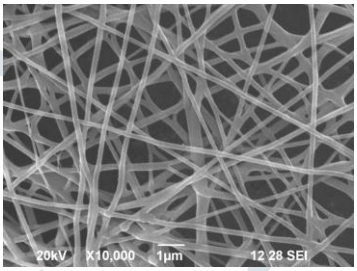

Fig : 3 – SEM (x 10,000)

3.2 FTIR Spectral Study:

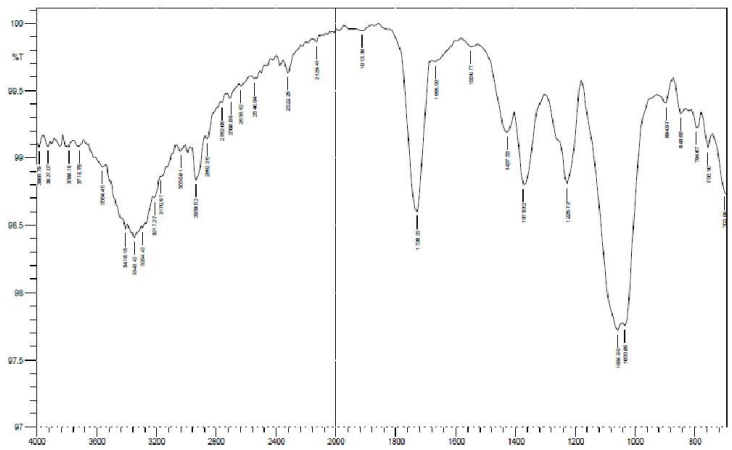

Fig : 4 - FTIR

Anti bacterial activity :

Tab : 1 – Results of Antibacterial Activity

Sample. NO	Hours of deposition in electrospinning	INHIBITION ZONE IN mm
1.	4	0.00 ±0.00
2.	6	1.29 ±0.45
3.	8	1.5 ±0.30

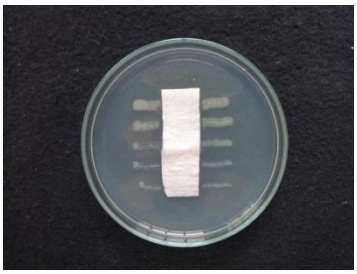

Fig : 5 - Sample 2

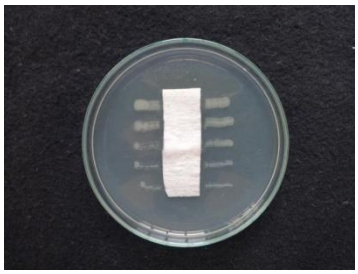

Fig : 6 - Sample 3

3.6 Bleeding Time Analysis :

Tab : 2 – Results of Bleeding Time

S. NO	Samples	BLEEDING TIME [SECS]
1.	15% coated	42
2.	10 % coated	75
3.	5 % coated	105

3.5 Blood Clotting Time :

Tab : 3 – Results of Blood Clotting Time

S. NO	Samples	CLOTTING TIME [MINS]
1.	15% coated	4 min 33 sec
2.	10 % coated	6 min 52sec
3.	5 % coated	8 min 45 sec

3.3 Drug Release Test :

Tab : 4 - Optical density measured for the release concentrations of Chitosan from the fabric samples

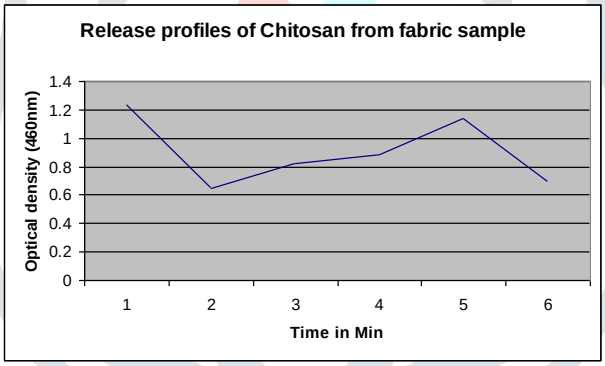

Fig : 7 - Release profiles of electro-spun chitosan from fabric samples

3.4 Bio Compatibility Test:

No irritation scores (IS) was developed for the sample during the contact period of sample on CAM according to the standard IS [B] analysis. When compared to negative control no irritation endpoints were developed on CAM for the treated sample. So the provided sample was considered to be biocompatible.

4. CONCLUSION

In this study, PVA/Chitosan nanocomposite fibers were prepared by electrospinning method. The weight ratio of PVA: Chitosan was fixed at 70:30 in1% Acetic acid. The suitable concentration condition of the solution for Chitosan/Montmorillonite deposition is derived 70/30 through drug release evaluation due to the maximum fiber yield. Further more good deposition of coating on nano film was resulted as 15% through bleeding time and blood clotting evaluation hence final product is evaluated in wound healing in a rat model results in Montmorillonite is having good in blood clotting function and combined with that chitosan having higher efficacy in faster rate of wound healing. The result says about Montmorillonite is good in blood clotting but making some restrictions to releasing drug. Hence lower concentration of Montmorillonite gives blood clotting with good rate of wound healing in higher combination of chitosan.