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Formulatuon and Evaluation of Neomycin Patches for Wound Healing Activity

Sunil Sangare, Nidhi Jain, A K Pathak

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Sunil Sangare, Nidhi Jain, A K Pathak
Department of Pharmacy Barkatullah University, Bhopal-462026

Correspondence
Sunil Sangare
Department of Pharmacy Barkatullah University, Bhopal-462026

ABSTRACT

The purpose of this project work to develop a antibacterial patch that may stick to the wounds, providing protection against bacterial infection without disturbing the healthy tissues present around the wound. As there is no external agent that can heal the wound, as body has its own wound healing mechanism, only thing that can be done is protecting the wounds against bacteria so healing can be fast. Here is film is prepared using neomycin antibacterial agent and using polymer gelatin that too has anti bacterial effect. The neomycin patch will be biocompatible material without given any side effect to the applied natural systems. The incorporation of PEG with gelatin has the aim of developing a material that would have good mechanical strength, be thermally stable on human body, and have good swelling property and effective water absorption capacity. The prepared will enhance both the rapidity of healing including reducing infection, pain, and scarring. An improved dressing also will reduce cost by improving the rate of wound healing and shorter the duration the treatment.

Keywords: Curcuma caesia, Curcuma longal, Rhizome, Volatile Oil

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. Their primary function was to keep the wound dry by allowing evaporation of wound exudates and preventing entry of harmful bacteria into the wound. It has now been shown however, that having a warm moist wound environment achieves more rapid and successful wound healing. Other factors which have contributed to the wide range of wound dressings include the different type of wound (e.g. acute, chronic, exuding and dry wounds, etc.) and the fact that no single dressing is suitable for the management of all wounds. In addition, the wound healing process has several different phases that cannot be targeted by any particular dressing.

The variety of wound types has resulted in a wide range of wound dressings with new products frequently introduced to target different aspects of the wound healing process. The ideal dressing should achieve rapid healing at reasonable cost with minimal inconvenience to the patient. This work offers a review of the common wound management dressings and emerging technologies for achieving improved wound healing. It may also prove to be novel polymers used for the delivery of drugs for acute, chronic and other types of wound. Effective wound management depends on understanding a number of different factors such as the type of wound being treated, the healing process, patient conditions in terms of health (e.g. diabetes), environment and social setting, and the physical chemical properties of the available dressings.

Wound healing progresses through a series of interdependent and overlapping stages in which a variety of cellular and matrix components act together to re establish the integrity of damaged tissue and replacement of lost tissue Controlled release of drugs to a given target generally involves prolonging the action of the active drug over time by allowing continual release from a polymeric dosage form. The use of hydrophilic polymers as controlled release dressings has great promise because of the potential advantages they offer .Controlled delivery dressings can provide an excellent means of delivering drugs to wound sites in a consistent and sustained fashion over long periods of time without the need for frequent dressing change.

2. MATERIALS AND METHODS

2.1 Preparation of gelatin-based membrane

Different concentration of gelatin granules were dissolved in distil water(50ml) with continuous stirring at 60^0C to make a viscous solution (the final volume was 25 ml). Then the solution was cast at room temperature. The films (membrane) were formed after 48 h of casting. The membranes of gelatin were collected, and then subjected to further drying in desiccators for 2 days. Then the membranes were stored in desiccators prior to testing. The membranes of gelatin/PEG were also prepared by solution casting. The constant quantity of drug and vanillin (1:6 ratio) was entrapped and different percentages of PEG (1–10% w/v) were added to the gelatin solution.[1]

Table No.1: Formulation of Neomycin Sulphate patches

Formulation code	Geletin (w/v) %	Peg400 (v/v)%	Neomycin (w/v)%	Vanillin (w/v)%	Water (ml)
F1	8	5	.02	0.12	50
F2	9	5	.02	0.12	50
F3	10	5	.02	0.12	50
F4	10	7.5	.02	0.12	50
F5	10	10	.02	0.12	50

2.2 Characterization of Film (patches)

2.2.1 Physical appearance

All the prepared patches were visually inspected for color, clarity, flexibility and smoothness.[2]

2.2.2 Thickness uniformity

The thickness of the formulated film was measured at 3 different points using a mitutoya thickness gage 7301 made in Japan thickness of three reading was calculated.[3]

2.2.3 Folding endurance

The folding endurance was determined to determine flexibility of film. The flexibility of the film is needed to handle the film easily and for comfortable, secured application of film on the wound. It was determined by repeatedly folding one film at same place till it breaks or folded up to 300 times manually. The number of times of film could be folded at the same place without breaking give the value of folding endurance.[4]

2.2.4 Water absorption capacity

It is of utmost importance, if they are used for biological applications and wound healing. It is used to measure the capacity of film to absorb wound exudates. The initial weight of 1inch of dry film was noted. Then this film was placed in 15ml. of distilled water taken in petri plate. The weight of the film was noted periodically at first hour, second hour, third hour and 24^{th} hour. Every time after noting the weight, the film was placed in fresh water. Water absorption capacity of the film was calculated using a formula:

$$\% \text{ moisture absorption} = \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100$$

2.2.5 Percentage moisture loss

The films were weighed accurately and kept in a desiccators containing anhydrous calcium chloride 22. After 3 days, the films were taken out and weighed. The moisture loss was calculated using the formula:[6]

$$\% \text{ moisture loss} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

2.2.6 Water vapor transmission rate

Glass vials of 5 ml capacity were washed thoroughly and dried to a constant weight in an oven. About 1 g of fused calcium chloride was taken in the vials and the polymer films of 2.25 cm2 were fixed over the brim with the help of an adhesive tape. Then the vials were weighed and stored in a humidity chamber of 80-90 % RH condition for a period of 24 h 7, 23. The vials were removed and weighed at 24 h time intervals to note down the weight gain.[7]

Transmission rate = Final weight – Initial weight X 100

Time x Area

2.2.7 Tensile strength

Tensile strength of the film was determined with Universal strength testing machine (Hounsfield, Slinfold, Horsham, U.K.). The sensitivity of the machine was 1 g. It consisted of two load cell grips. The lower one was fixed and upper one was movable. The test film of size (4 × 1 cm2) was fixed between these cell grips and force was gradually applied till the film broke 17, 24. The tensile strength of the film was taken directly from the dial reading in kg. Tensile strength is expressed as follows:[8]

Tensile Strength = Tensile load at break

Cross section area

2.2.8 Uniformity of weight

The film was cut into 10 patches of 1cm2 each and their average weight was calculated. Percentage deviation from average weight for each patch was also determined.[9]

2.2.9 Moisture content

The film was weighed and kept in a desiccators containing calcium chloride at 40oC in a drier for at least 24 h or more until it showed a constant weight. The moisture content was the difference between the constant weight taken and the initial weight and was reported in terms of percentage (by weight) moisture content.[10]

2.2.10 Drug content

An accurately cut patch of 1cm2 area was taken and added to a beaker containing 1 ml phosphate buffer solution of pH 7.2 The beaker was kept 24 hours with occasion shaking. The sample was analyzed drug content using UV spectrophotometer 248nm.This study was performed for 3 times for a single patch.[11,12]

2.2.11 In vitro drug release studies [13]

Franz diffusion cell consists of an upper donor compartment and the lower receptor compartment, surrounded by water jacket for circulation of water to maintain the temperature inside at 32 ± 10C.The uniformity of solution in the receptor phase was maintained by stirring at high speed of 100 rpm (approx) using a tiny magnetic bead the volume of receptor compartment was maintained at 60 ml and the diffusional surface are of 0.785 cm^2.The receptor compartment was provided with the sampling port on one side, to withdraw sample at the predetermined time intervals for estimation of drug content by UV spectrophotometer.

3. RESULTS AND DISCUSSION

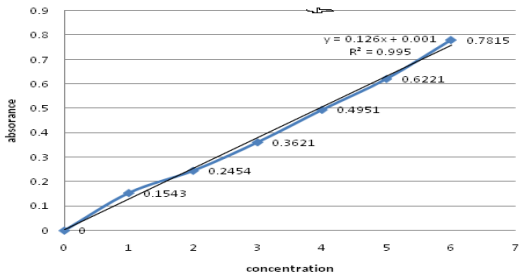

Fig. 1: Standard calibration curve of neomycin sulphate with vaniline (1:6) in PBS 7.4.

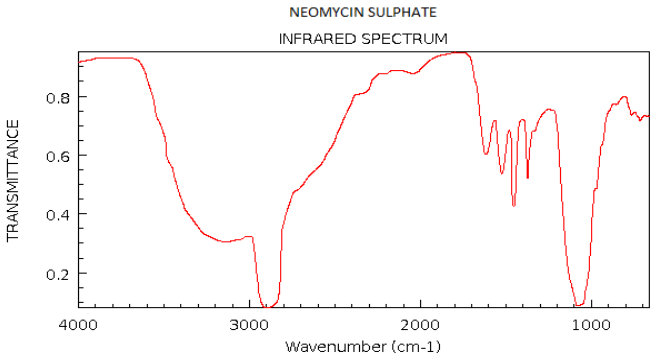

Fig. 2: IR Spectra of neomycin sulphate

Table No. 2: Physiochemical evaluation parameters

Formulation Code	Thickness (mm)	Folding endurance	Weight Variation (mg)	Tensile strength(kg/mm^2)
F1	0.36+0.02	265+10	354+4.03	15+0.32
F2	0.41+0.03	255+12	395+2.42	18+0.43
F3	0.42+0.024	248+06	321+5.32	17+0.38
F4	0.45+0.012	258+04	344+4.25	16+0.76
F5	0.39+0.054	267+06	329+2.98	14+0.45

Table No. 3: Physiochemical evaluation parameters

F. Code	%Water Absorption Capacity	% Moisture loss	% Drug content (mg)	Water vapors transmission rate
F1	5.6	1.2	92+2.03	0.145+0.21
F2	5.7	1.5	93+3.05	0.136+0.32
F3	6.1	1.7	91+2.04	0.132+0.22
F4	6.8	1.4	94+1.11	0.144+0.21
F5	6.9	1.8	95+0.11	0.133+0.45

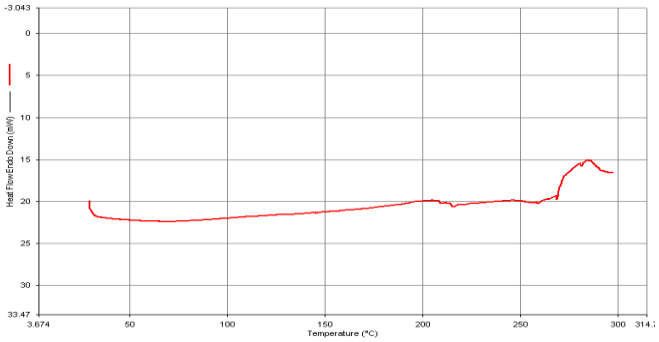

Fig. 2: DSC of formulation F4

Table No.4: in-vitro release profile of neomycin patches F1-F5

	% drug release				
TIME (hr)	F1	F2	F3	F4	F5
0	0	0	0	0	0
1	10.02	11.92	11.73	12.82	11.87
2	15.31	16.03	15.11	17.32	15.91
3	19.36	21.91	20.07	23.85	21.49
4	24.68	26.79	24.88	28.27	25.55
5	29.41	30.91	29.96	34.91	29.93
6	33.51	35.42	35.24	40.81	33.6
7	37.91	40.92	40.74	45.36	38.98
8	42.5	44.41	45.90	50.13	44.50

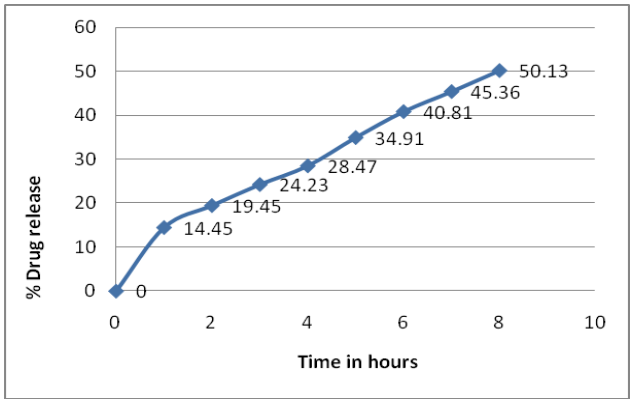

Fig. 3: In- vitro drug release profile of formulation f4

4. CONCLUSION

In this research, a bioadhesive wound dressing material based on gelatin was prepared, characterized, and evaluated for biomedical application. All the formulation were evaluated for thickness, folding endurance, moisture content, physical appearance, water absorption capacity, drug content and results found for all satisfactory. DSC studies reveled that the drug and polymer were compatible with each other and all the batches prepared and evaluated, formulation code F4 showed promising result. It was conclude that the concentration of gelatin (10%) and peg-400 (10%)are useful in formulation show optimum physical and mechanical properties. moreover, F4 patches exhibited better in vitro drug release time profile. Thus this research has revealed a successful development and application of a new bioadhesive wound dressing material based on modified gelatin which is more effective that conventional wound dressing materials.

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