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Formulation and Evaluation of Aloevera Based Norfloxacin Gel for Burn Wound Care

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ABSTRACT

Norfloxacin is a broad- spectrum fluoroquinolone antibacterial agent and has shown effective in the treatment of burn wound infections caused by invading organisms, particularly pseudomonas strains resistant to silver sulfadiazine. The present study aimed to develop a Norfloxacin Aloe vera- based gel formulations and to evaluate the effect of aloe vera gel for the effective treatment of burn wound infections. Different formulations (F1-F4) of Norfloxacin Aloe vera gel were prepared using dispersion technique, where in varying concentrations of carbopol 934 were used and prepared gel was evaluated for its pH, viscosity, drug content, *in-vitro* diffusion and *in-vitro* antimicrobial activity. The pH, viscosity and drug content of the formulations were found to be satisfactory. *In- vitro* diffusion data revealed better permeation characteristics. The prepared Norfloxacin Aloe vera gel showed synergetic antimicrobial activity when compared with the pure Norfloxacin and pure Aloe vera.

Keywords: Norfloxacin, Aloe vera, Carbopol, antimicrobial activity.

INTRODUCTION

Water and germs are kept out from the body by the skin. Wounds and traumas obliterate the barrier that ordinarily keeps germs, fungus, and viruses out. Wound healing is a complicated and dynamic process of cellular and tissue layer restoration[1].

According to the World Health Organization, more than 300,000 people die each year as a result of fire-related burns, with scalds and other types of burns accounting for the rest (e.g. caused by electricity, chemicals radiation, etc.). Burn injuries are, without a doubt, among the most difficult to treat. Deep wounds cause significant fluid loss and substantial tissue damage, impairing several important activities performed by skin. It will become vulnerable to gram-negative bacteria such as E. coli, Pseudomonas aeruginosa, Enterobacter species, Actinobacter species, Proteus species, Klebsiella species, and gram-positive bacteria such as Staphylococcus aureus, Enterococcus species, and others. This will eventually result in burn wound infection and non-healing, which will result in death[2].

By giving topical antibiotics as an adjuvant therapy to systemic dosage, a suitable antibacterial therapy should be initiated in time to avoid major skin damage. This lowers the overall serum antibiotic/antimicrobial concentration while simultaneously raising the local concentration to bactericidal levels.

Norfloxacin NF, a broad-spectrum fluoroquinolone antibacterial agent, is commonly used to treat urinary and genital tract infections and has shown to be effective in the treatment of burn wound infections caused by invading organisms, particularly Pseudomonas strains resistant to Silver Sulfadiazine[3].

Many topical formulations are available in the market, but some of them have a tendency to develop pseudo eschar, which is difficult to distinguish from burn–eschar and may also obstruct medicine entry into the burn wound. However, water can significantly improve medication and perhaps other drug absorption through burn eschar.

Transdermal gels are a relatively recent type of topical dosage forms that entrap a large amount of hydrophilic medication within the major category of topical dosage forms. Norfloxacin is challenging to incorporate into transdermal gels due to its hydrophobic nature.

As a result, a Norfloxacin gel was developed. Gels have been proven to be superior topical formulations for the delivery of hydrophobic medicines over creams and ointments due to their wide range of application[4].

Aloe Vera (Aloe barbadensis Miller) is a perennial plant in the Liliaceae family.. It has anti-inflammatory, anti-cancer, anti-microbial, anti-diabetic, and immunomodulatory properties. Because of its medicinal and emollient characteristics, aloe vera has been used in a variety of commercial goods. The wound-healing function of central parenchyma is due to its acetylated mannan[5].

Hence, the goal of this study was to develop and evaluate Norfloxacin transdermal gel utilizing Aloe Vera as the gel foundation.

MATERIALS AND METHODS

Norfloxacin was purchased from Yarrow chem. product Ltd., Mumbai, Carbopol940, methyl paraben, propyl paraben, sodium hydroxide, potassium dihydrogen phosphate, methanol was purchased from S.D. Fine Chem.Ltd., Mumbai, India.Aloevera is locally available source.

Preformulation study

The initial stage in the formulation of any dosage form is to conduct a preformulation study. A preformulation study was conducted prior to the development of the dosage forms. The process of optimizing the full determination of physicochemical features of a new compound that may affect medication performance and the development of an efficacious, stable, and safe dosage form is referred to as preformulation study. It provides the necessary information to characterize the nature of the drug substance and to lay the foundations for the drug's combination with pharmaceutical excipients in the dosage form. As a result, preformulation experiments for identification and compatibility investigations were carried out on the drug sample obtained [6].

FI-IR study

Fourier transform infrared (FT-IR) technique was used to study the physical and chemical interaction between the drug and excipients used. FI-IR spectra of pure drug and physical mixture of drug and polymer were recorded using KBr mixing method on FT-IR instrument (FT-IR-1700, Shimadzu).

Differential scanning calorimetry (DSC)

DSC was used to study physical and chemical interaction between the drug and excipients used. DSC spectra of pure drug and drug composite mixture were recorded on DSC-60 instrument (DSC-60, Shimadzu).

Preparation of norfloxacin aloe vera gel

To avoid the acidity in preparation, the central parenchymatous pulp was scooped out with a spatula from the Aloe leaves and washed repeatedly with water before being treated with 0.1 N sodium hydroxide (NaOH). To get the juice, the treated pulp was placed in a blender. Vacuum filtering was used on the juice that was obtained. 1 percent and 2 percent w/w Carbopol 940 were added to the clear liquid and evenly dispersed, ensuring no lumps. In a small amount of ethanol, norfloxacin, methyl paraben, and propyl paraben were dissolved and added to the above mixture. Drop by drop, 0.1 N NaOH solution was added until a gel was formed. The prepared Norfloxacin-Aloe vera gel was weighed and kept in a dark room in airtight containers.

Characterization of gels

Visual examination

Gels are inspected for homogeneity, color and lumps by visual inspection[8]

Percentage practical yield

Knowing the practical and theoretical yields, the percentage yield was calculated. Equation was used to calculate it.

$$\%\ yield = \frac{Practical\ weight\ of\ gel}{Theoretial\ weight\ of\ drug + weight\ of\ polymer} \times 100$$

pH measurement

At 37°C, the pH was measured with a calibrated digital pH meter. All of the pH readings were done in triple[8].

Drug content determination

A specified quantity of gel was dissolved in phosphate buffer pH 7.4 in a volumetric flask. It was shaken for 2 h on a mechanical shaker to get complete solubility of the drug. The

solution was the filtered. After suitable dilution of the filtrate, absorbance was recorded using UV-visible spectrophotometer. The results were shown in table 3. Averages of 3 sets of values were taken.[8]

Viscosity:

The viscosity of prepare formulations was studied using Brookfield viscometer (LVDV-E model) using suitable spindle.[5]

In-vitro Drug Release Study (Diffusion study)

Using a modified in vitro permeation equipment, the *in vitro* release of drug from formulations (F1 to F4) was studied across a cellophane membrane.

Phosphate buffer pH 7.4 was used as the dissolving medium. A cellophane membrane was tied to one end of a specially made glass cylinder after becoming soaked overnight in the dissolution medium (open at both ends and of 3.4 cm diameter called as donor chamber). On the membrane that was fixed to the donor chamber, 1gm of the formulation was taken. The membrane was just contacting the receptor medium surface when the glass cylinder was joined to the metallic shaft and suspended in 50 ml of dissolving medium. The medium was kept at 37^0 C and swirled at 50 RPM with a magnetic stirrer. 5 mL aliquots were taken from the receptor medium at regular intervals. It had been filtered and, if necessary, diluted and finally analyzed by UV spectrophotometer[9].

In-vitro antimicrobial activity

Antimicrobial activity tests were performed to determine the formulations' biological activity. The organisms utilized as test organisms are E. coli. The antimicrobial activity was measured using the Cup-Plate method and an agar diffusion test. Known concentrations of sterile Norfloxacin (standard solution), aloe vera solution, and the developed formulation (test solutions). These solutions were put into cups bored into sterile nutrient agar previously seeded with test organisms (E. coli), and the agar plates were incubated at 37°C for 24 hours after allowing the solutions to permeate for 2 hours. The zone of inhibition (ZOI) around each cup was measured and compared to the control. Except for the incubation, the entire procedure was carried out in a laminar airflow unit[10].

RESULT AND DISCUSSION

Preformulation studies:

EVALUATION OF NORFLOXACIN - ALOE VERAGEL

Percentage practical yield

The results of % practical yield studies were shown in table no2. As the amount of polymer in the formulation increases, the percent practical yield decreases.

Surface pH

Because an acidic or alkaline formulation is known to irritate the mucosal membrane, this characteristic is important when it comes to skin development. The pH of the formulations F1 and F2 ranges between 7.1 and 7.2 on the surface. Within an acceptable range, each sample was analyzed in triplicate (n=3). The results show that all of the formulas have a pH that is acceptable. As a result, there's a chance they won't irritate the skin topically.

Determination of drug content

Results of drug content are shown in Table 2. The drug content of different gel formulations were estimated and the results were in official limit with range of 90 to 96% which indicate uniform distribution of drug throughout the gel. This shows that the method used to prepare the gel was approximate and that no drug was lost throughout the procedure.

In Vitro Diffusion study

The in vitro release of Norfloxacin from different aloe vera based gel formulation at 37° C was investigated and the results are represented in Fig.1. It was noticed that the release of Norfloxacin from different aloe vera based gel formulations can be ranked in the following order: F1>F2>F3>F4. The results showed that as the polymer concentration increases, the amount of drug release was

reduced, and this effect remained throughout the study. The prepared formulations did not show the initial burst release of drug, which could be explained by the fact that these systems were viscous and hard. This shows that as the polymer content increased, the gel structure become more closely packed and served as a more resistant barrier to drug release of drug.

Kinetic Analysis of the Drug Release

The release data analysis was carried out using the various kinetic modules using cumulative % release vs. time (Zero order kinetic model); log cumulative % drug retained vs. time (first order kinetic model) and cumulative % drug release vs. square root of time (Higuchi model. The correlation coefficient (R2) values are tabulated in table 3. All formulation showed first order release kinetics and diffusion model kinetic respectively.

Antimicrobial activity

The antibacterial activity of optimized gel formulation and pure Norfloxacin and pure aloe vera are shown in table 4 and Fig.2. The zone of inhibition was taken as measure of the antibacterial activity. The greatest activity was observed with optimized formulation where the zone of inhibition was 10mm, while lowest activity was found with pure aloe vera ie. 5mm where zone of inhibition for pure Norfloxcin was 7mm. The optimized formulation showed higher antibacterial activity due to the synergetic effect of Norfloxcin and aloe vera.

Table no.1 Formulation design of Norfloxacin gel

Ingredients	F1	F2	F3	F4
Norfloxacin (mg)	100	100	100	100
ALOE VERA (ml)	7.5	7.5	7.5	7.5
Carbopol 940 (mg)	100	150	200	250
Methyl paraben (mg)	0.02	0.02	0.02	0.02
Propyl paraben (ml)	0.02	0.02	0.02	0.02
Water Up to (ml)	QS	QS	QS	QS

Table no .2 Evaluation parameters of Norfloxacin gel

Formulation code	% yield	pH	Drug content(%)	Viscosity Cpc
F1	96.22	6.24±0.44	90.83±1.62	1152
F2	95.84	6.52±0.19	95.47±1.58	1356
F3	95.12	6.71±0.62	95.10±1.24	1423
F4	94.66	6.78±0.38	96.22±0.98	1488

Figure No.1 *In vitro* diffusion profile of Formulations

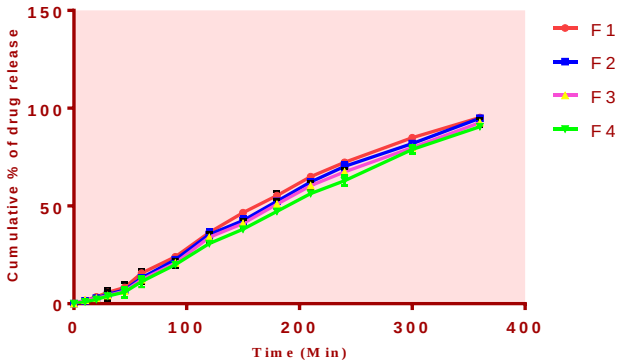

Table.3 The kinetic study of the *in vitro* release data of Norfloxacin from is different gel formulations

Formulation code	Correlation coefficient (R2)		
	Zero order	First order	Diffusion
F1	0.978	0.984	0.9719
F2	0.979	0.988	0.9821
F3	0.981	0.991	0.990
F4	0.976	0.992	0.979

Table no. 4 Antimicrobial activity of Norfloxacin gel formulation

Formulation	Zone of inhibition (Diameter in mm)
Control	0
Pure Norfloxacin	7
Pure Aloe vera	5
Combination of Norfloxacin and Aloe vera	10

CONCLUSION

Norfloxacin aloe vera - based gel formulations were prepared using aloe vera and carbopol as gelling agent. All the formulations showed result within acceptable range for various test. Thus, desirable goals could be achieved by systematic formulation approach. The antibacterial activity showed that developed gel formulation can reduce the bacterial load on burn wound and thus, is more effective as compared to pure Norfloxacin. This optimized formulation may be an alternative to the conventionally administered topical formulations for burn wound.

CONFLICT OF INTEREST

The authors declare that this article content has no conflict of interest.

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REFERENCE

1. Marta Madaghiele, Christian Demitri, Alessandro Sannino, Luigi Ambrosio. Polymeric hydrogels for burn wound care: Advanced skin wound dressings and regenerative templates. Burns & Trauma, 2014, 2(4). 153-16.
2. Saranya TV, Manoj K.Formulation, Evaluation and Optimization of Novel Silver Sulfadiazine Loaded Film Forming Hydrogel For Burns. Hygeia. J. D.Med 2016:.8 (2); 1-10.
3. Kamal Dua, Venkata Ramana Malipeddi, Jyotsna Madan, Gaurav Gupta, Srikumar Chakravarthi, Rajendra Awasthi, Irene Satiko Kikuchi, and Terezinha De Jesus Andreoli Pinto. orfloxacin and metronidazole topical formulations for effective treatment of bacterial infections and burn wounds. Interv Med Appl Sci. 2016 Jun 1; 8(2): 68–76.
4. Geetha Bhat, Praveen Kudva, and Vidya Dodwad. Aloe vera: Nature's soothing healer to periodontal disease. J Indian Soc Periodontol. 2011; 15(3): 205–209.
5. Abdul Wadood Khan, Sabna Kotta, Shahid Hussain Ansari,Rakesh Kumar Sharma, Amit Kumar, and Javed Ali. Formulation development, optimization and evaluation of aloe vera gel for wound healing. Pharmacogn Mag. 2013; 9(1): S6–S10.
6. Niazi SK. Handbook of pharmaceutical manufacturing formulations, vol.3 .3rded. USA: Inform a Healthcare; 2004. p. 156.
7. Pharmacopoeia of India. 1996; 2(3): A-143.
8. Y.PrasannaRaju,K.Haritha,RaoP.Satyanarayana,K.R.Vandana,D.ThusharaBindu, V. Vinesha and V. Harini Chowdary. Formulation and Characterization of Aceclofenac -*Aloe vera* Transdermal gel. *Current Drug Delivery*, 2015,*12*,703-708.
9. Patel P, Javia A, Sheth AK. Formulation and evaluation of sustained release chlorhexidine *in-situ* gel for periodontitis. Int J Pharm Sci. 2013; 4(4): 465-78.
10. Abdul Wadood Khan, Sabna Kotta, Shahid Hussain Ansari1, Rakesh Kumar Sharma2, Amit Kumar2, Javed Ali Formulation development, optimization and evaluationof aloe vera gel for wound healing 2013 (9).
11. Supriya Chatla, Prasanthi*, V. Padmaja Preparation and Evaluation of Aloe-Vera Hydro-Gel containing Antibiotic 202013(4)