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RESEARCH ARTICLE

# Preparation and Evaluation of Aloe-Vera Gel for Aphthous Ulcer

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**Abstract:** Aloe vera gel formulations were developed for the treatment of recurrent aphthous ulcers. Three gel formulations were prepared using varying concentrations of carbopol 934 (1%, 1.5%, 2%) as the gelling agent. Aloe vera extract (2% w/v) was used as the active component along with methyl and propyl parabens as preservatives. Triethanolamine was used to adjust the pH of the gels. The prepared gels were evaluated for appearance, pH, viscosity, spreadability and in-vitro drug release. All formulations had a clear glassy appearance. The pH ranged from 6.2-6.5. Viscosity decreased with increasing shear rate indicating pseudoplastic flow. Spreadability also decreased with increase in carbopol concentration. Formulation F3 with 2% carbopol showed the maximum sustained release of 63.24% over 8 hours making it the optimized formulation. Hence, aloe vera gel formulated with carbopol 934 could be used for the localized treatment of recurrent aphthous ulcers. The mucoadhesive properties of the gel aid in increasing the residence time at the site of application and facilitating sustained drug release for effective therapy. Further clinical studies are necessary to evaluate the efficacy of these gel formulations.

**Keywords:** Aloe vera; Apthous ulcer; Oral gels; Carbopol; Herbal remedies.

## 1. Introduction

The exploration of local antimicrobial delivery aims to overcome the limitations of conventional therapy. Sustained release formulations are gaining interest for delivering antibacterial agents to infection sites, offering long-term efficacy with significantly reduced doses. Transdermal drug delivery presents an attractive yet challenging research area, providing non-invasive, convenient, and self-administrable options. Among transdermal formulations, gels are preferred due to their ease of application and enhanced percutaneous absorption. A gel, defined as a semi-solid dispersion system, can range from weak to hard and tough. Ulcers, resulting from breaks in the skin or mucous membranes, vary from small painful sores to serious lesions in the stomach or intestines. Recurrent aphthous stomatitis, a common form of oral ulceration, manifests as recurring sores in healthy individuals, often found in the inner lips, cheeks, tongue, or soft palates. Oral ulcers can also be indicative of systemic disorders, including inflammatory bowel disease. [1] The focus on plant research worldwide has uncovered the immense potential of medicinal plants. Aloe vera, belonging to the Liliacea family, has been traditionally used for health, beauty, and medicinal purposes. Known for its wound healing properties, Aloe vera has demonstrated benefits as a radiation protector. Utilizing the oral mucosa for drug delivery offers several advantages. It prolongs the residence time of the dosage form at the absorption site, preventing first-pass metabolism, enhancing drug absorption, and subsequently improving therapeutic efficacy. The excellent accessibility of the oral mucosa, coupled with rapid absorption facilitated by abundant blood supply and flow rates, contributes to increased drug bioavailability. This approach also shields the drug from degradation in the acidic gastrointestinal environment. [2,3] Additionally, the convenience of administration and improved patient compliance are noteworthy benefits. Furthermore, exploiting the mucosal surface results in a faster onset of action. The objective of this work is to explore and emphasize the potential of using Aloe vera to treat Aphthous ulcers.

## 2. Materials and Methods

### 2.1. Materials

Carbopol 934 was supplied by S.D. Fine Chem. Ltd in Mumbai, India, while Methyl Parabeen and Propyl Parabeen were sourced from Karnataka Fine Chem. in Bangalore and S.D. Fine Chem. Ltd in Mumbai, India, respectively. Triethanolamine was obtained from Ranbaxy Laboratory in Punjab.

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### 2.2. Preparation of Aloe vera gel

For the preparation of the gel, a specific quantity of Methyl and Propyl Parabeens was added to the aloe vera solution. Following this, Carbopol solution was introduced into the mixture and triturated until a gel consistency was achieved. Triethanolamine was then added dropwise to maintain the pH of the solution, which was eventually adjusted to 100 ml with distilled water. The composition design of various Aloe vera gel formulations (F1, F2, and F3) is presented in Table 1, indicating the percentage weight/volume of each ingredient in 100 ml. This comprehensive approach to formulation involves carefully measured quantities of Aloe vera, Carbopol 934, Methyl Parabeen, Propyl Parabeen, Triethanolamine, and distilled water to achieve the desired gel formulations [4-6]

**Table 1.** Composition design of various Aloe vera gel formulations:

| **Name of the Ingredient** | **Quantity in 100 ml (%w/v)** | | |
|---|---|---|---|
| | **F1** | **F2** | **F3** |
| Aloe vera %W/V | 2 | 2 | 2 |
| Carbopol 934 %W/V | 1.0 | 1.5 | 2.0 |
| Methyl parabeen % W/V | 0.03 | 0.03 | 0.03 |
| Propyl parabeen %W/V | 0.01 | 0.01 | 0.01 |
| Triethanolamine | q.s | q.s | q.s |
| Distilled water | q.s | q.s | q.s |

### 2.3. Evaluation of prepared gel

#### *2.3.1. Appearance*

All formulations were subjected to visual inspection for their physical appearance.

#### *2.3.2. pH Determination*

The pH of the gel formulations was determined using a digital pH meter. In this process, 1g of gel was dispersed in distilled water, left for 2 hours, and adjusted to a 1% solution. The pH was measured using a digital pH meter, and the procedure was performed in triplicate. [7]

#### *2.3.3. Viscosity and Rheological Studies*

A Brookfield digital viscometer was employed to evaluate the viscosity and rheological properties of the gel formulations. This involved measuring viscosity at different angular velocities (0.5 to 2.5 rpm) at 25°C using spindle no 7. [7]

#### *2.3.4. Spreadability Assessment*

Spreadability was determined by applying an excess of the gel between two glass slides, compressing to a uniform thickness with a 1000 gm weight for 5 min. The time taken for the upper glass slide to move over the lower plate was measured to quantify spreadability (S). [8]

#### *2.3.5. In-vitro Release Studies*

*In-vitro* release studies were conducted using the membrane diffusion technique. One gram of the gel formulation was placed in a glass tube covered with a cellophane membrane, acting as a donor compartment. The tube was immersed in a beaker with phosphate buffer (pH 5.0) as a receptor compartment, maintained at 37±1°C. Samples were withdrawn at specific intervals for analysis at 220 nm in a UV spectrophotometer. The experiments were conducted in triplicate [9]

## 3. Results and discussion

### 3.1. Appearance

All prepared formulations exhibited a glassy appearance, indicating a common visual characteristic across the formulations.

### 3.2. Viscosity and rheology

A Brookfield digital viscometer with spindle no 7 was utilized to determine the viscosity and rheological properties of Aloe vera gel formulations, all of which used Carbopol as the gel base. The viscosity results are presented in Table 2. The results indicated pseudo-plastic flow characteristics, displaying non-Newtonian flow (shear thinning). Formulations with lower resistance to flow under high shear rates are preferred for topical application.

**Table 2.** Viscosity of Aloe vera gels.

| Shear Rate (RPM) | Viscosity of the formulations (cps) | | |
|---|---|---|---|
| | F1 | F2 | F3 |
| **5** | 196800 | 488800 | 367200 |
| **10** | 110000 | 271600 | 210400 |
| **15** | 78,400 | 189300 | 145300 |
| **20** | 61400 | 145800 | 110000 |
| **25** | 50560 | 119500 | 92640 |

### 3.3. Spreadability

Spreadability assessments were conducted on different gel formulations, and the results are summarized in Table 3. The spreadability of the gels decreased with an increase in the concentration of Carbopol, an important feature for topical applications requiring a thin layer. [10]

**Table 3.** Spreadability of Aloe vera gels

| Formulation code | Spreadability(gm.cm/sec) |
|---|---|
| F1 | 7.41 |
| F2 | 7.23 |
| F3 | 6.83 |

### 3.4. *In vitro* drug release studies

The *in-vitro* drug release profile of Aloe vera from gels with varying concentrations of Carbopol is illustrated in a figure. Formulations F1 and F2, with lower Carbopol concentrations, exhibited 85.02% and 75.19% drug release within 5.30 hours. Formulation F3, with a higher polymer concentration, showed 63.24% drug release at the end of 8 hours. F3, displaying sustained drug release, was selected as the optimized formulation for periodontal treatment.

## 4. Conclusion

In conclusion, this study investigated the formulation and characteristics of Aloe vera gel with varying concentrations of Carbopol. The formulations exhibited a glassy appearance, and their rheological properties indicated pseudo-plastic flow with non-Newtonian characteristics. Spreadability decreased with an increase in Carbopol concentration, an essential consideration for topical applications requiring a thin layer. The in-vitro drug release study revealed that formulations with lower Carbopol concentrations achieved higher drug release percentages within a shorter time, while a higher concentration led to sustained drug release over 8 hours. Among the formulations, F3, containing a higher Carbopol concentration, emerged as the optimized formulation for periodontal treatment due to its sustained drug release profile. Overall, this study provides valuable insights into the rheological and drug release properties of Aloe vera gel formulations, offering a foundation for optimized topical applications in the realm of periodontal treatment.

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## Author's short biography

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