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Formulation And Evaluation Of Herbal Nasal Gel Barrier For Allergic Rhinitis Using Pour Forming Method

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A B S T R A C T

This project aims to produce an herbal nasal gel barrier useful in the treatment of allergic rhinitis. Included are active pharmaceutical components (APIs) like eucalyptus oil and peppermint essential oil, which are recognized for their anti-inflammatory, decongestant, and soothing qualities. Tea tree oil and other natural ingredients improve the antimicrobial and anti-allergen properties. The gel is essentially changing conventional antihistamine treatment by creating a physical block against allergens. The formulation's stability was assessed to see whether it could be used as a harmless or efficient medication.

Keywords: Allergic Rhinitis, Eucalyptus oil, Tea tree oil, Mentha piperita oil, Herbal nasal gel barrier etc.

1. INTRODUCTION

1.1 ALLERGIC RHINITIS:

The worldwide majority of people are afflicted by allergic rhinitis (AR), a chronic illness [1]. It is IgE-mediated early and late-phase hypersensitivity responses[1,2]. Because of the non-life-threatening nature of symptoms, AR in the past has been considered a trivial disease. Congestion, itching, rhinorrhea, and sneezing are some of the nasal symptoms of AR, in addition to ocular symptoms like itchy, watery eyes, and redness. It has been demonstrated that AR has a detrimental effect on productivity and lifestyle quality, including the development of emotional challenges and a decline in sleep, social interaction, daily activities, and work and academic performance. The allergic response is classified into early and late-phase reactions. In the early phase, allergic rhinitis is an immunoglobulin (Ig)E-mediated response against inhaled allergens that cause inflammation driven by type 2 helper (Th2) cells[3].

The first reaction, which takes around five to fifteen minutes after exposure to an antigen, leads to the degranulation of host mast cells. This results in the release of a variety of pre-existing and newly produced mediators, such as histamine, which is one of the primary causes of allergic rhinitis. The treatment of allergic rhinitis often involves the use of antihistamines or nasal corticosteroids, avoiding known allergens, and immunotherapy and herbal nasal allergance barriers to decrease the body's responsiveness to allergenic substances. Effective treatment and symptom reduction can be achieved by understanding the causes and triggers of allergic rhinitis.

1.2] GELS:

Gels are an intermediate state of matter containing both solid and liquid components. The solid component comprises a three-dimensional network of interconnected molecule or aggregates which immobilizes the liquid continuous phase [4,5].

1.3] Importance Of In Situ Gelling System: [6]

i. The major importance is the possibilities of administrating accurate &reproducible quantities compared to already formed gel.

ii. In-situ forming polymeric delivery system such as ease of administration &reduced frequency of administration improved patient compliance & comfort.

iii. Poor bioavailability & therapeutic response exhibited by conventional ophthalmic solution due to rapid precorneal elimination of drug may be overcome by use of gel system that are instilled as drops into eye &undergoes a sol-gel transition from instilled dose.

iv. Liquid dosage form that can sustain drug release & remain in contact with cornea of eye for extended period of time is ideal.

v. Reduced systemic absorption of drug drained through the nasolacrimal duct may result in some undesirable side effects.

1.4] NASAL ANATOMY AND PHYSIOLOGY:

The nasal mucosa has become an established administration site for systemic drug delivery and a desirable alternative to parenteral medication since it is amenable to self-medication, has potential for direct-to-central nervous system delivery, no first-pass metabolism, non-invasiveness and virtually painless. From a pharmacokinetic standpoint, intranasal administration circumvents first-pass elimination and drug absorption is rapid due to the existence of a rich vasculature and a highly permeable structure within the nasal membranes [7,8]

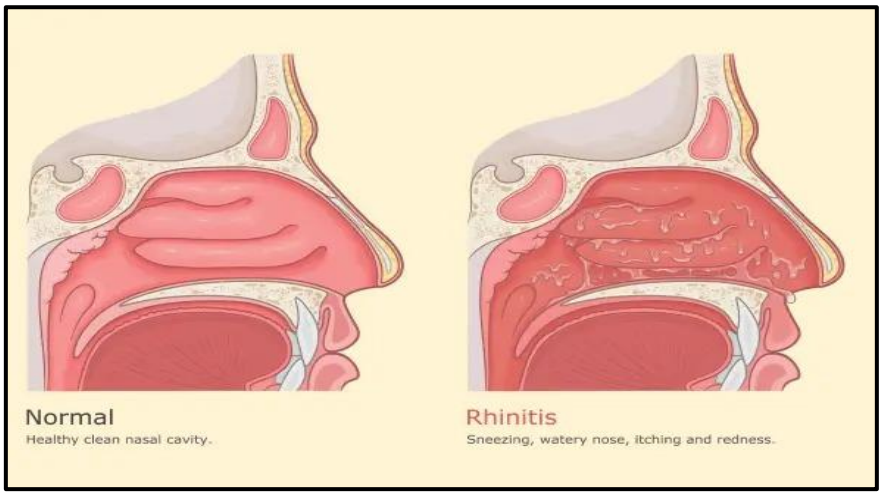

Fig. 1. Normal and Allergic Rhinitis Nasal Cavity.

1.6] Film forming system:

Film forming system (FFS) is a novel and innovative approach which can be used as an alternative to conventional topical and transdermal dosage formulations. It is defined as non-solid dosage form (such as gels and solution), it produces a film in situ i.e. after application on the skin. The formed film can either be a solid polymeric material that acts as matrix for sustained release of drug hrough the skin or a residual liquid film which is rapidly absorbed in the stratum corneum [9,10,11].

1.7] Mechanism of Film Formation and Permeation:

Film forming system is applied directly to the skin and it forms a thin, transparent film insitu by solvent evaporation. After application of the formulation to the skin, the composition of the FFSs changes significantly due to the loss of the volatile components of the vehicle which results in the formation of residual film on the skin surface [12,13].

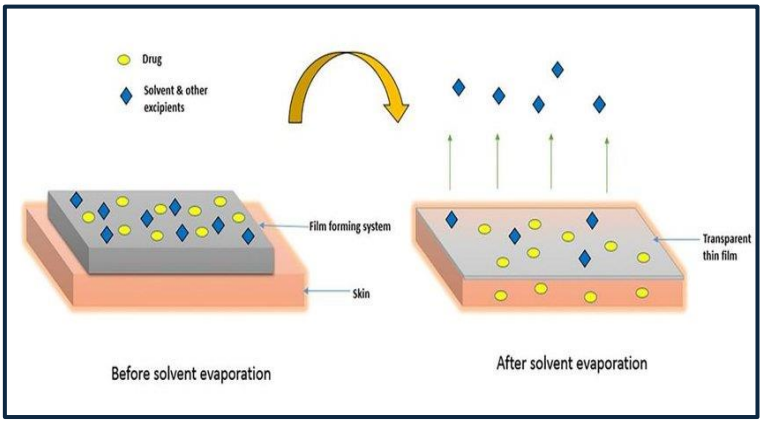

Fig. 2. Mechanism of film formation

1.8] Mechanism of drug absorption by nasal route:

The first step in the absorption of drug from the nasal cavity is passage through the mucus. Small and uncharged particles easily pass through the mucus layer. However, large or charged particle may find it difficult to cross the mucus layer. Mucin, which is the principal protein in the mucus, has the potential to bind to solutes and thus hinders the diffusion of drugs. After a drug's passage through the mucus, there are several mechanisms for absorption through the mucosa [14].

1.9] The advantages of in situ nasal gels over other nasal formulations include:

- Reduction in post-nasal drip into the back of the throat and therefore minimization of bad taste problem and loss of drug from the nasal cavity.
- Reduction in anterior leakage of the drug out of the nasal cavity
- Localization of formulation on the mucosa thereby providing a better chance for the drug to be absorbed.Gels can afford the use of soothing agents or emollients which may not be sutaible for solutions, suspensions or powder dosage form so can reduce irritation potential.
- Can be developed for both systemic and local delivery, and vi) precise dose can be administered by the use of metered dose nasal actuator system [15].

II. MATERIALS AND METHOD

1] Materials:

1.1) Selection of essential oil:

A) Eucalyptus Oil:

- **Synonyms:** Eucalyptus, Stringy Bark Tree, Blue gum, Blue Gum Tree.
- **Biological Source:** Eucalyptus oil is the essential oil obtained by the distillation of fresh leaves of *Eucalyptus globulus* and other species like *E. polybractea, E. viminalis*, and *E. smithii*, belonging to family *Myrtaceae.*
- **Geographical Source:** It is mainly found in Australia, Tasmania, United States, Spain, Portugal, Brazil, North and South Africa, India, France, and Southern Europe.
- **Chemical Constituents:** Eucalyptus oil contains volatile oil of which 70 to 85% is 1,8-cineole also known as eucalyptol. The other constituents present are p-cymene, α-pinene; small quantity of sesquiterpenes like ledol, aromadendrene; aldehydes, ketones, and alcohols. It also has polyphenolic acids like ferulic acid, caffeic acid, gallic acid; flavonoids such as eucalyptin, hyperoside and rutin [16].
- **Use in AR:** Relieves nasal congestion and reduces inflammation [18].

B) Peppermint Oil:

- **Synonym:** Brandy Mint.
- **Botanical Source:** It is the oil obtained by the distillation of *Mentha piperita*, belonging to family *Labiatae*.
- **Geographical Source:** It is mainly found in Europe, United States, and also in damp places of England.
- **Chemical Constituents:** The chief constituent of Peppermint oil is Menthol, along with other constituents like menthyl acetate, isovalerate, menthone, cineol, inactive pinene, limonene, and other less important bodies [17].
- **Use in AR:** Alleviates nasal itching and irritation, and acts as a natural decongestant [18]

C] Tea Tree Oil: Use in AR: Reduces allergens and alleviates nasal irritation and congestion [18].

2] Method: Pour f\Forming Method:

2.1] Preparation of Herbal Nasal Gel Barrier:

a] Formulation Table:

Sr. No	COMPOSITION	F1
1	HPMC	0.4g
2	Carbopol 934P	0.6g
3	Triethanolamine	0.2ml
4	Tea tree oil	0.5ml
5	Eucalyptus oil	1.0ml
6	Peppermint oil	0.8ml
7	Glycerin	0.5ml
8	EDTA	0.1g
9	Aloe Vera Gel	0.5ml
10	Propylene glycol	0.1ml
11	Petroleum jelly	0.5ml
12	Vitamin E	0.2ml
13	Citric acid	Qs
14	Distilled Water	Qs

Table No. 1. Ingridents table

B) PROCEDURE:

a) Preparation of Carbopol Gel: Weight 0.6g of Carbopol add in 30ml Distilled water.

Solution A :

1. The prepared carbopol gel was mixed with HPMC solution.
2. Add 0.2ml triethanolamine in the above mixture.
3. Simultaneously prepare solution B.

Solution B:

1. Make the mixture of the essential oil.
2. 1ml Eucalyptus oil + 0.8ml Peppermint oil + 0.5ml Tea tree oil
3. Apply constant stirring.
4. Add 0.1g of EDTA to the above oil mixture (keep stirring)
5. With continuous stirring add 0.5ml glycerin in the mixture.

Solution C:

i. Mix solution A in Solution B.

ii. Stir it for 15mins on magnetic stirrer.

iii. Add 0.2ml of Vitamin E in the solution.

iv. Then add 0.1ml Propylene Glycol and 0.5ml of Aloe Vera gel to the mixture.

v. Final volume made up with desired quantity of distilled water.

vi. The solution was kept on magnetic stirrer until a uniform solution was obtained which was kept at 4^{o}C overnight to allow complete swelling so that a homogeneous gel was formed [19].

vii. Add the desired quantity of citric acid to adjust the pH of the formulation.

Fig. 3. (a) Formulation Consistency **(b) Formulation was prepared**

IV. EVALUTION PARAMETERS:

1] pH DETERMINATION:

i. The pH of all the formulated herbal gels was measured by using digital pH meter[20].

ii. The pH meter was first calibrated with distilled water adjusting the pH on 7.

iii. And then the pH meter electrode was dipped in the formulation to record the pH..

2] pH NEUTRALIZATION:

i. Slowly add a small amount of citric acid solution (e.g., 0.1-0.5 mL) to the herbal nasal barrier while stirring.

ii. Use the pH meter to measure the pH after each addition of citric acid.

iii. Continue adding small amounts of citric acid and measuring the pH until the target pH range is reached.

iv. Once the target pH range is reached, verify the pH using the pH meter.

3] SPREADABILITY: [21]

i. After one minute, the spreading diameter of one gram of gel between two horizontal plates (20 cm x 20 cm) was measured to assess the gel formulations' spreadability.

ii. The upper plate was subjected to a standard weight of 125 grams.

iii. To calculate the spreadability coefficient, the following formula was used:

iv. S=ML/t

Where, M = weight tied to the slide (g), L = length of the slide moved (cm), T = time (sec)

S= ML/t

M = 125 g, L = 1.8 cm, T= 9 sec

S = (125)(1.8)/9 = 25g.cm/s

4] STABILITY:

1) Store the gel at different temperature e.g. 25°C, 40°C, etc.

2) For a specified period e.g., 1 months.

3) Observe if changes occur in the pH, Viscosity, or other.

V. RESULTS:

1) Evalution parameters results -

Sr No.	Evalution Parameters	Results
1.	pH Determination	2.03 pH
2.	pH Neutralization	7.0 pH
3.	Spreadability	25g.cm/s

Table No. 2. Evalution Parameters Results

2] Stability Results -

Stability Parameters	After 1 Month (stored in 4°C)
Colour	No Change
Odor	No Change
Smoothness	Slightly changed
Consistency	Slightly changed
Skin Irritation	No irritation reaction shown
pH	6.8 pH

Table No. 3. Stability Results

VI. DISCUSSION:

The prepared formulation is white in color has camphoraceous smell and is smooth and has gel consistency. The gel did not show any skin irritation reactions. The pH of the formulation was recorded to be 2.03 which is highly acidic and not suitable for to the nasal mucosal environment and hence the pH of the formulation was neutralized to 7.0 pH. The gel was easily spreadable and it took around 9 seconds for the two slides to separate.

VII. CONCLUSION:

To sum up, on the basis of the above study on the herbal nasal barrier, the nasal barrier are considered as an promising approach or a useful medication for treating allergic rhinitis or other allergic reaction in the nasal cavity caused by the allergens present in our environment. The formulation's herbal ingredients like eucalyptus oil for its anti inflammatory activity , peppermint oil for its natural decongestant activity , and tea tree oil for its anti allergen activity makes it a stronger and safe, non-invasive, and eco-friendly, hence proving to be a better option to nasal care products. The formulated in-situ nasal herbal gel showed good pH, spreadability, consistency, viscosity and was found to be non irritant. However, in future further in vivo studies are required to confirm the pharmacological activity of the gel.

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