

FORMULATION AND EVALUATION OF LOCAL ANESTHETIC GEL FROM DATURA STRAMONIUM

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ABSTRACT

Datura stramonium is a wild plant having various medicinal and pharmacological properties and these properties exploited for cancer, rheumatism, ear pain, headache, wound, burn, stress, depression, insomnia, asthma, boils and inflammation. Datura stramonium, exhibits pharmacological effect and prepared as herbal or botanical drugs by pharmaceutical industries for many diseases. Wound healing is the complex which requires proper healing from both internal and external. The development of the anti-inflammatory, antimicrobial gel aims to enhance better recovery of the wound and avoid any infection, especially during the postoperative phase, where there is lots of medications prescribed which suppress immune system, making wound more prone to the microbial attack and resulting in late recovery of the wound. The main component of the plant is alkaloid, which shows the antimicrobial, anesthetic, anti-inflammatory, cytotoxic and analgesic characteristic which accelerate the wound healing process and prevent microbial infestations. The findings suggest that the datura -based gel not only offers a natural alternative to synthetic antifungal agents but also presents a promising option for treating fungal infection. The purpose of current study concludes with recommendations for further research into the gel's formulation stability and potential application in clinical setting, emphasizing the importance of exploring herbal remedies in modern medicine.

KEYWORDS: - Datura stramonium, Botanical drugs, Anti-inflammatory, Anesthetic & modern medicine etc.

INTRODUCTION

HERBAL MEDICINE:

Plants have been used for thousands of years as medicine in Egypt, China, India, and Greece. Today, 80% of rural residents rely on herbal medicine, a product made from plant. The use of herbal remedies has increased in developed nations, with the European Scientific cooperative on phytotherapy offering monographs on specific herbs. A committee was created in 1992 to create standards and guidelines for herbal medicine evaluation.[3]

HERBAL PLANTS

Medicinal plants throughout the ages, humans have relied on nature for their basic needs, for the production of food, shelter, clothing, transportation, fertilizers, flavors and fragrances, and medicines. Man relied on the healing properties of medicinal plants. Some people value these plants due to the ancient belief which says plants are created to supply man with food, medical treatment, and other effects. It is thought that about 80% of the 5.2 billion people of the world live in the less developed countries and the World Health Organization estimates that about 80% of these people rely almost exclusively on traditional medicine for their primary healthcare needs.

Medicinal plants are the “backbone” of traditional medicine, which means more than 3.3 billion people in the less developed countries utilize medicinal plants on a regular basis. There are nearly 2000 ethnic groups in the world, and almost every group has its own traditional medical knowledge and experiences.[5]

Medicinal plants have been used in healthcare since time immemorial. Studies have been carried out globally to verify their efficacy and some of the findings have led to the production of plant-based medicines. The global market value of medicinal plant products exceeds \$100 billion per annum. This paper discusses the role, contributions and usefulness of medicinal plants in tackling the diseases of public health importance, with particular emphasis on the current strategic approaches to disease prevention. A comparison is drawn between the ‘whole population’ and ‘high-risk’ strategies. The usefulness of the common factor approach as a method of engaging other health promoters in propagating the ideals of medicinal plants is highlighted. The place of medicinal plants in preventing common disease is further examined under the five core principles of the Primary Health Care (PHC) approach. Medicinal plants play vital roles in disease prevention and their promotion and use fit into all existing prevention strategies. However, conscious efforts need to be made to properly identify, recognize and position medicinal plants in the design and implementation of these strategies. These approaches present interesting and emerging perspectives in the field of medicinal plants. Recommendations are proposed for strategizing the future role and place for medicinal plants in disease prevention.

Plants have formed the basis of sophisticated traditional medicine systems that have been in existence for thousands of years and continue to provide mankind with new remedies. Although some of the therapeutic properties attributed to plants have proven to be erroneous, medicinal plant therapy is based on the empirical findings of hundreds of thousands of years of use.[8]

HERBS: -

An herb is a plant part used for its scent, flavor, or therapeutic properties. Herbal medicines are a type of dietary supplement. They are sold as tablets, capsules, powders, teas, extracts, and fresh or dried plants. People use herbal medicines to try to maintain or improve their health.

Many people believe that products labeled “natural” are always safe and good for them. This is not necessarily true. Herbal medicines do not have to go through the testing that drugs do. Some herbs, such as comfrey and ephedra, can cause serious harm. Some herbs can interact with prescription or over-the-counter medicines.

If you are thinking about using an herbal medicine, first get information on it from reliable sources. Be sure to tell your health care provider about any herbal medicines you are taking.

LOCAL ANESTHETIC

Local anesthesia (local anesthetic) is medication that healthcare providers use to temporarily numb a small area of your skin, subcutaneous tissue and peripheral nerves before minor procedures. Local anesthetics can also treat some painful conditions and relieve pain after surgery.

Local anesthesia numbs a small section of your body, like a specific area of skin on your arm or part of your gums, for example. It can affect your muscle function, as well, depending on which nerves are targeted. Unlike with general anesthesia, you don't lose consciousness with local anesthesia. But providers sometimes combine local anesthesia with sedation so you feel relaxed. Some medications containing mild local anesthetics – like cold sore gels – are also available as prescriptions or over-the-counter products.[9]

Types

Local anesthetics come in many forms depending on their intended purpose, including:

- Creams
- Eye drops
- Gels
- Implants
- Injections
- Ointments
- Skin patches
- Sprays

A few examples of local anesthetics healthcare providers are include:

- Benzocaine
- Bupivacaine
- Cocaine
- Lidocaine
- Ropivacaine with or without mepivacaine
- Tetracaine

DATURA

Datura is a genus of nine species of highly poisonous, vespertine – flowering plants belonging to the nightshade family (Solanaceae). They are commonly known as thornapples or jimsonweeds, but are also known as devil's trumpets or mad apple (not to be confused with angel's trumpets, which are placed in the closely related genus Brugmansia). Other English common names include moonflower, devil's weed, and hell's bells. All species of Datura are extremely poisonous and psychoactive, especially their seeds and flowers, which can cause respiratory depression, arrhythmias, fever, delirium, hallucinations, anticholinergic toxidrome, psychosis, and death if taken internally.[14]



Figure 1: Datura flower

The name *Datura* originates from the Hindi and Sanskrit words for “thorn-apple” with historical and cultural signification in Ayurveda and Hinduism while the America term “jimsonweed” derives from its prevalence in Jamestown, Virginia, where it was called “Jamestown-Weed.” *Datura* species are herbaceous annual or short-lived perennial plants up to 2 meters tall with trumpet-shaped flowers and spiny fruit capsules historically used in traditional medicine especially in India, where they hold cultural and ritual signification. *Datura* species classification is complex due to high variability and overlapping traits among species, with many “new species” later reclassified as local varieties or subspecies; most species are native to Mexico, though some have disputed native ranges outside the America, and the genus is closely related to *Brugmansia* and the recently established *Trompettia*.



Figure 2: *Datura* fruit

Due to their effects and symptoms, *Datura* species have occasionally been used not only as poisons, but also as hallucinogens by various groups throughout history. Traditionally, their psychoactive administration has often been associated with witchcraft and sorcery or similar practice in many cultures, including the western world. Certain common *Datura* species have also been used ritualistically as entheogens by some Native American groups.

Non – psychoactive use of plants in the genus is usually done for medicinal purposes, and the alkaloids present in some species have long been considered traditional medicine in both the New and Old World due to the presence of alkaloids scopolamine and atropine, which are also produced by plants associated with Old World medicine such as *Hyoscyamus niger*, *Atropa belladonna*, and *Mandragora officinarum*.

Taxonomical classification: -

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Clade: Eudicots

Clade: Asterids
Order: Solanales
Family: Solanaceae
Subfamily: Solanoideae
Tribe: Datureae
Genus: Datura

MATERIALS AND METHOD

Table 1: Ingredients Table

SR.NO	INGRIDENT	QUANTITY	PROPERTIES
01	Datura	0.6gm	Analgesic, anti-inflammatory, anesthetic etc
02	Liquid paraffin	24ml	Gelling agent
03	Methyl paraben	0.06gm	Preservative
04	Pepper mint oil	Q.S.	Cooling agent
05	Carbopol	1.8gm	Polymer
06	NAOH	Q.S.	Ph Adjuster
07	Distilled water	Q.S.	Vehicle



Figure 3: Ingredients and API

PREPARATION OF GEL:

Extraction of Datura

To extract Datura (commonly Datura stramonium or similar species) for use in a wound healing gel, it's important to follow a careful process, as the plant contains potent alkaloids like atropine and scopolamine, which can be toxic in high concentrations. However, when used correctly and in small, controlled doses, it can provide anti-inflammatory and analgesic benefits for topical application.[6]



Figure 4: Extraction of Crude Drug

Local anesthetic gels containing either Datura or plant extract 1% were prepared using carbomer as a gelling agent. The composition of formulation is showed. Carbopol gel was prepared by dispersing carbopol powder in sufficient quantity of deionized water with the aid of magnetic stirrer (1500 rpm). The drug or the plant extract were added to make 1% concentration, then the pH was adjusted to pH 7 to 7.5 using NaOH 10% with continuous stirring till gel was formed.[18]

PROCEDURE:

First clean and dry all the glassware and equipments that are used to make the gel



Then weigh accurately all the Active pharmaceutical ingredients and excipients that are used according to given above the table.



The carbopol 934 was soaked in de-ionized water first.



And neutralizer was added in it.



Now APIs (Datura extract) are introduced slowly in it with continuous stirring.

After the addition of APIs co-solvent (propylene glycol) was added.



Then addition of Preservatives is done in formulation.



After addition of this all APIs and excipients stirring is done until a homogeneous product is formed.

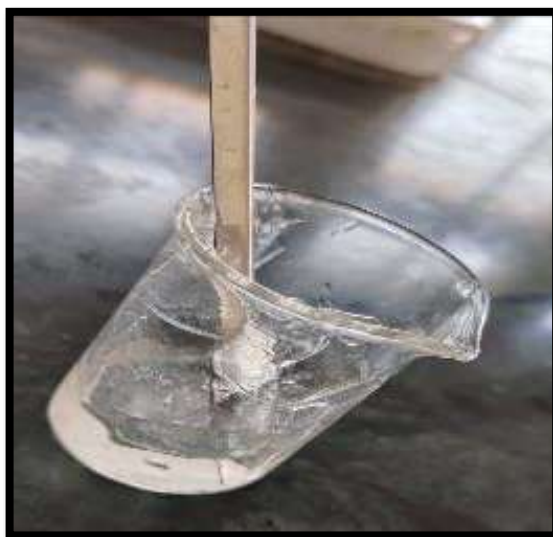


Figure 5: Prepared Gel

EVALUATION OF GEL:

Physicochemical Properties The gel was evaluated for its physicochemical properties, including:

pH: The pH of the gel was measured using a digital pH meter.



Figure 6: pH test

Viscosity: The viscosity was measured using a Brookfield viscometer to assess the flow properties of the gel.



Figure 7: Viscosity test

Spreadability: The Spreadability test was conducted to determine how easily the gel could be spread over a wound surface.

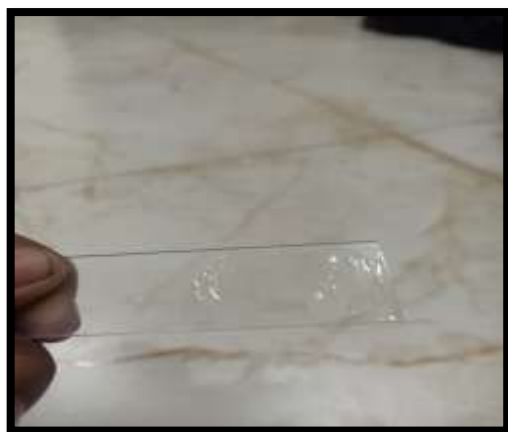


Figure 8: Spreadability test

Stability: The gel's stability was assessed by storing it at varying temperatures (4°C and 25°C) for three months and evaluating changes in texture, color, and consistency.

Antibacterial Activity: The antibacterial activity of the gel was tested against common wound pathogens, including *Staphylococcus aureus* and *Escherichia coli*, using the agar well diffusion method. Zones of inhibition were measured after 24 hours of incubation.

Washability Test: For ten minutes, a portion of the gel was placed to the hand's skin and left to flow under the force of the tap water. The moment the gel was entirely withdrawn was recorded.

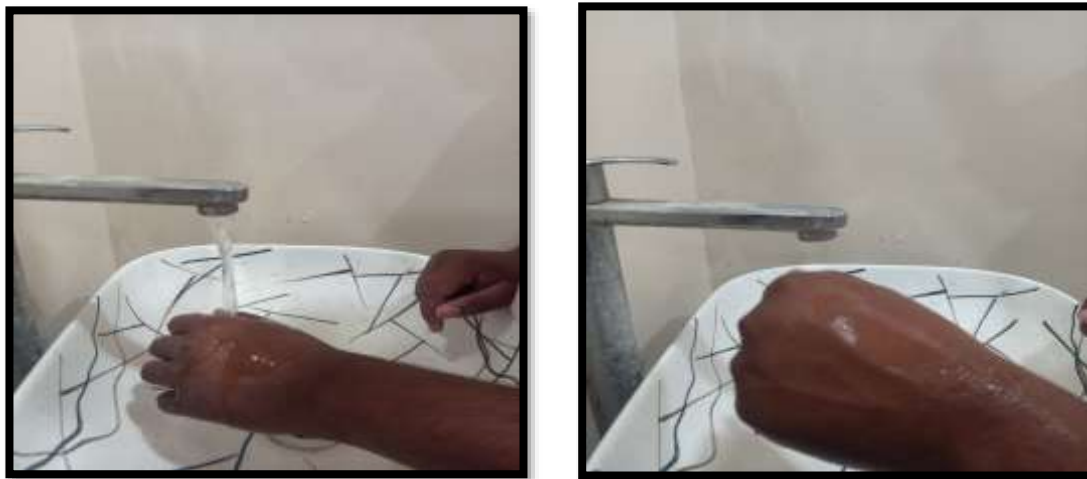


Figure 9: Washability Test

Homogeneity: The formulation were tested for homogeneity by visual appearance and by touch.

Appearance: The appearance of gel was very clear.

Acid Value: Take 10gm of substance dissolve in accurately weighed in 50ml mixture of equal volume of alcohol and solvent ether. The flask was connected reflux condenser and slowly heated, until sample was dissolved completely. To this 1ml of phenolphthalein added and titrated with 0.1N NaOH, until faintly pink colour appears after shaking for 30sec. $\text{Acid Value} = n \times 5.61 / w$ = number of ml of NaOH required w= weight of substance.

Irritancy test: Mark an area (1 sq. cm) on the left hand dorsal surface. The local anesthetic gel was applied to the specified area and time was noted. Irritancy, erythema, edema, was checked if any for regular intervals upto 24hrs and reported.



Figure 10: Irritancy test

In vitro permeation studies: In vitro permeation studies of TRA gel across goat skin were carried out using two-chambered Franz-type diffusion cells (manufactured “in house”) having a receptor phase of ~5 ml, 2 and a diffusional area of ~0.788 cm². Adult goat skin was used for permeation studies at 37 ± 0.5 °C. Abdominal full thickness skin of male goat was carefully excised after sacrificing the goat. Subcutaneous fats and other extraneous tissues adhering to the dermis were completely removed and trimmed with forceps and scissor. The skin was cleaned with phosphate buffered saline (PBS) at pH 7.4 and stored in 500 ml normal saline in a refrigerator (18 – 20 °C). The skin was used within one week of excision. Sheets of the skin were cut to appropriate sizes 2 (~ 1 cm in diameter) and soaked overnight in the receptor solution (PBS). The membrane was then placed between the two compartments of the diffusion cells with epidermis side facing the donor compartment while the dermal side was bathed with PBS at pH 7.4 (receptor fluid). The donor compartment was filled with PBS at pH 7.4 ± 0.1 . This pH is close to that of human skin. The receptor fluid was stirred with a magnetic stirring bar at 500 rpm, keeping the temperature at 37 ± 0.5 °C by means of a water jacket. Care was exercised to remove any bubbles between the underside of the skin and the solution in the receiver compartment. Vacuum grease was used to produce a leak-proof seal between the membrane and the two compartments of the diffusion cell, i.e., donor and receptor. Ultrasonic bath. To avoid evaporation from the compartments, the cell arm and donor compartment were covered with a para film. Constant mixing of the receptor phase was obtained with a magnetic stirrer placed in the receptor compartment. The diffusion cells were placed on a stirring-bed immersed in a water bath at 37 ± 0.05 °C, to maintain the temperature of membrane surface. After 24 hours, both chambers were cleared of PBS. Enhancement ratio (ER) was calculated by dividing the flux of the test formulation by the flux of control formulation.

Statistical analysis: The receptor and donor compartments were filled with PBS at pH 7.4 ± 0.1 . To remove air bubbles and preclude the development of air pockets in the receptor phase, PBS was degassed in gel. The results are expressed as mean $\pm$ standard deviation (SD, n = 5). Statistically significant differences between various permeation data were determined using F-test, Fisher’s least significant difference (LSD), analysis of variance (ANOVA) and multiple range tests at 95% confidence level.

Preference Test: The parameters of preference tests based on sensory evaluation were a scent, color, and sensation on the skin. The level of preference was assessed using a numerical scale, i.e. 5 = like extremely, 4 = like, 3 = neutral, 2 = dislike, 1 = dislike extremely.

Test for thermal stability: Thermal stability of the formulation gel was determined by the humidity chamber controlled at 60- 70% RH and $37 \pm 1^\circ\text{C}$.

Patch test: About 1-3gm of material to be tested was placed on a piece of fabric or funnel and applied to the sensitive part of the skin e.g. skin behind ears. The cosmetic to be tested was applied to an area of 1sq.m. of the skin. Control patches (of similar cosmetic of known brand) were also applied. The site of patch is inspected after 24 hrs. As there was no reaction the test was repeated three times. As no reaction was observed on third application, the person may be taken as not hypersensitive.

RESULT & DISCUSSION:

The purpose of current study concludes with recommendations for further research into the gel's formulation stability and potential application in clinical setting, emphasizing the importance of exploring herbal remedies in modern medicine.

The formulations have shown stability over 45 days period at $37^\circ\text{C} + 20$ and $45^\circ\text{C} + 20^\circ\text{C}$. The procured sample of Datura gel was tested for its identification. The quality of Diclofenac was confirmed by physical characterization, melting point, chemical test and UV-absorption maximum methanol. The results of these entire tests were in compliance with specification of Indian Pharmacopoeia. The IR- spectrum obtained for identification of Diclofenac. The different formulations using various water and ethanol Proportion were developed. Ethanol, propylene glycol has become recognized as a possible permeation enhancer in the topical drug delivery of drugs and to produce proper viscosity Carbopol 940 and h was used in combination.

Table 2: Evaluation Parameter and their result:-

S. no.	Parameter	Standard	Result
1.	Ph	4.84-7.41	6.06
2.	PKa	4.15	4.12
3.	Viscosity	10000 cp	3023.81 cp
4	Spreadability	23.05 cm	23.03cm
5.	Physical Appearance	Clear	Transparent
6.	Skin irritation	No irritation	No irritation
7.	Melting Point	275-277	276.4
8.	Solubility	Water	Soluble
9.	Washability	Easily washable	Yes

Table 3: Organoleptic test

S. No.	Organoleptic features	Observations
1	Colour	Transparent
2	Odour	Aromatic & Pungent
3	Taste	Aromatic, bitters
4	Texture	Smooth

CONCLUSION:

Topical gels continue to emerge as a viable platform for localized and systemic drug administration, delivering a mix of patient comfort, excellent drug penetration, and convenience of application. Advances in polymer science, nanotechnology, and smart delivery systems have considerably broadened their therapeutic potential beyond conventional dermatological applications. Despite the advances, obstacles persist in obtaining constant skin penetration, long-term stability, and patient-specific personalization. Ongoing research focusing on bioresponsive materials, customized therapy, and regulatory harmonization is likely to further develop gel-based delivery methods. Overall, topical gels lie at the confluence of innovation and clinical usefulness, prepared to play an increasingly crucial role in contemporary pharmaceutical and cosmetic formulations.

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