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To Formulate and Evaluate a Polyherbal Gel Containing Marigold for its Wound Healing Activity

Wani Pratiksha[1], Vitnor Rutuja[2], Prof. More Ashwini. B[3]
Students, Pratibhatai Pawar Collage of Pharmacy Wadala Mahadev, Shrirampur[1,2]
Assistant Professor, Pratibhatai Pawar Collage of Pharmacy Wadala Mahadev, Shrirampur[3]

Abstract: *Herbal gel is a jelly-like substance that is applied to the skin. It can be soft or slightly firm, depending on how it is made. People use it to protect the skin, treat infections, reduce swelling, and keep the skin healthy. It is made by mixing one or more natural herbs in the right amounts. Unlike regular treatments that only focus on symptoms, herbal gels try to fix the root cause and improve overall well-being. They are popular because they absorb quickly, are not greasy, feel cool and refreshing, and are usually safe for sensitive skin. Herbal gels can help with many skin problems like acne, dryness, sunburn, and signs of aging. Ingredients like Moringa oleifera, which has antioxidant and anti-inflammatory powers, are used to help the skin heal. Other common natural ingredients include marigold leaves, neem, aloe vera, and honey, which are known for their soothing and healing effects. To make the gel, all the ingredients are heated and mixed well for about 10 to 15 minutes until smooth. After making it, the gel is tested for things like pH level, thickness, appearance, how easily it spreads, possible skin irritation, and how much is in the container to make sure it is safe and effective.*

Keywords: Marigold leaf, Neem, Aloe vera; Herbal extract; Herbal gel

I. INTRODUCTION

The skin acts as a protective barrier that keeps out water, bacteria, viruses, and fungi. When the skin gets injured or wounded, this barrier is damaged, making it easier for harmful germs to enter the body. Healing a wound is a complicated process that involves repairing damaged cells and rebuilding skin layers. In adults, wound healing happens in three main stages: inflammation, tissue growth (proliferation), and remodeling. Each of these stages involves many different steps, like the movement of immune cells to the wound, cleaning out dead tissue, forming new blood vessels, and building up new skin layers. In the end, the body replaces the damaged skin with scar tissue made by special cells called fibroblasts.

The goal of treating wounds is to help them heal as quickly as possible, with little pain, discomfort, or scarring. To do this well, it's important to understand how wounds heal and how things like nutrition affect the process. The FDA (Food and Drug Administration) classifies wound care products into three groups: solid dressings (like bandages), semi-solid products (like ointments, creams, and gels), and liquid cleansers. Using the right product can help speed up healing. One useful form is a gel. Gels are made with a special structure that holds a lot of water. When the gel uses water as the main liquid, it's called a hydrogel. These gels help keep the wound moist, soak up fluid from the wound, and can reduce pain by creating a cooling effect. They're also easy to put on and take off.

There are many wound-healing products available today, and most of them contain medicines that kill bacteria, like Neomycin, Mupirocin, Povidone Iodine, Hydrogen Peroxide, and Bacitracin. However, using these antimicrobial drugs too often can lead to bacteria becoming resistant, which is a growing concern in medicine. Because of this, researchers are now looking for safer, natural alternatives. Many plants found in nature have properties that help heal wounds, and scientists are studying them as potential new treatments.

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II. LITERATURE REVIEW

Sr. No	Author	Title	Summary
1	Pruthviraj Patil1,Vishal Rajput, Alpesh Patil, Pranjal Chougule	Formulation and Evaluation of a Polyherbal Gel for Skin Disorders	An herbal gel containing Marigold, Garlic, Honey, Cocoa Powder, and Aloe Vera was formulated and optimized for wound healing and antimicrobial activity. The optimized gel showed good stability, skin compatibility, and effective antimicrobial properties.
2	Naziya Pathan, SalmanPathan Varsharani Avhad	Formulation and Evaluation of Herbal Gel by using Lemongrass oil	Gels are semi-solid systems formed by a three-dimensional network that traps liquid, derived from the Latin word gelu meaning "freeze." They combine properties of both solids and liquids, as defined by USP.
3	Rituraj Rajjan Singh*, Somprabha Madhukar, Shruti Rathore	Formulation And Evaluation of Herbal Gel	Gels are easy to apply, non-greasy, and provide localized action with quick absorption, making them ideal for sensitive skin. However, they may dry out quickly, have limited drug capacity, and sometimes cause irritation due to added preservatives.
4	Sayali Sanjay Wagh and Bhavana Dnyandeo Tambe	Formulation and development of herbal gel for wound healing	Herbal gels are easy to use, portable, and beneficial for skin application due to their good spreadability. Moringa, known as the "Miracle Tree," offers antioxidant, anti-inflammatory, and anti-aging properties, supporting overall skin and health benefits.
5	Narjis Fatima, Anil Kumar,Sakshi Sharma, MS. Mansha	Preparationand evaluation Formulation of herbal gel	Physicochemical evaluations The gel made with Clerodendrum Serratum was checked by looking at its colour, smoothness, thickness, and to see if any layers had separated.

Aim:

To evaluate and compare the wound healing potential of Marigold (*Calendula officinalis*), Neem (*Azadirachta indica*), and aloe vera leaf extracts through in vitro andin vivo models.

Objectives:

1. Helps Reduce Premature Aging.
2. Treat Infections.
3. Reduces Inflammation.
4. Easy spread ability.
5. Good ability of absorbance in skin.
6. Treat hydration & sunburn.
7. Cooling effect.
8. Compatible with sensitive skin

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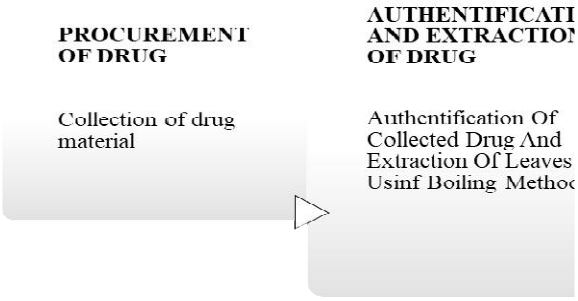
Plan of Work



Topical Drug Delivery System:

The main goal of any drug delivery system is to get the right amount of medicine to the right part of the body quickly and keep it working properly. The way a drug is given (called the route of administration) plays a big role in how well it works.

The skin is one of the easiest places on the body to apply medicine, which makes it perfect for topical treatments. Topical delivery means putting a medicine directly on the skin to treat skin problems like acne or conditions that show up on the skin, like psoriasis. The goal is for the medicine to work right where it's applied, either on the surface or just under the skin.

Creams, gels, and ointments (called semisolid forms) are the most common types used on the skin, but there are also sprays, foams, medicated powders, liquids, and adhesive patches.There are two types of topical treatments:

External topical: These are put on the skin to treat the affected area.

Internal topical: These are applied inside the body on soft tissues like the mouth, vagina, or rectum for local treatment.

Advantages of Topical Drug Delivery:

- Skips the liver's first-pass effect, so more of the drug works.
- Easy and convenient to use.
- Avoids the pain and risks of injections and the problems with drug absorption in thestomach.
- Can work well with a smaller dose, as the drug is delivered continuously.
- Keeps drug levels more stable in the body.
- Easy to stop using if needed.
- Covers a larger area than places like the mouth or nose.
- Can target a specific area of the body.
- Good for drugs that don't last long in the body.
- Helps improve how the body responds to the medicine.
- Easier for patients to follow treatment.
- Suitable for people to use on their own.

Disadvantages of Topical Drug Delivery:

- Can cause skin irritation or rashes.
- Some drugs don't pass through the skin well.
- Risk of allergic reactions.
- Only works well for drugs that need low levels in the blood.

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- Skin enzymes may break down the drug.
- Drugs with large particles may not absorb through the skin properly.

Skin:

The human skin is very important because it helps us feel things, protect our body, control temperature, defend against germs, and keep our body balanced. Our skin is always exposed to things like harmful sunlight, chemicals, and germs. In Ayurveda (an ancient Indian medicine system), skin is considered an important sense organ. Ayurveda has its own way of diagnosing and treating skin diseases, which it calls Kuṣṭha.

Sunlight has ultraviolet (UV) rays, and these can cause skin problems. UVB rays, especially, can harm the skin if we are exposed to them for a long time. Because people are more aware of skin aging and cancer caused by UV rays, many herbal skincare products are becoming popular.

Many sunscreens use chemicals like titanium dioxide and zinc oxide to block UV rays, but these chemicals can sometimes cause skin irritation or allergies. Herbal products, on the other hand, have been used for centuries to treat skin problems and are known for their healing properties.Scientists worldwide have studied herbal products and found that many have strong benefits for the skin, but more long-term research is still needed.

The skin has three main layers: the outer epidermis, the middle dermis, and the deeper hypodermis. Most research focuses on the first two layers, while the deeper layers get less attention.

Three layers of tissue make up the skin:

- Epidermis, the top layer.
- Dermis, the middle layer.
- Hypodermis, the bottom or fatty layer.

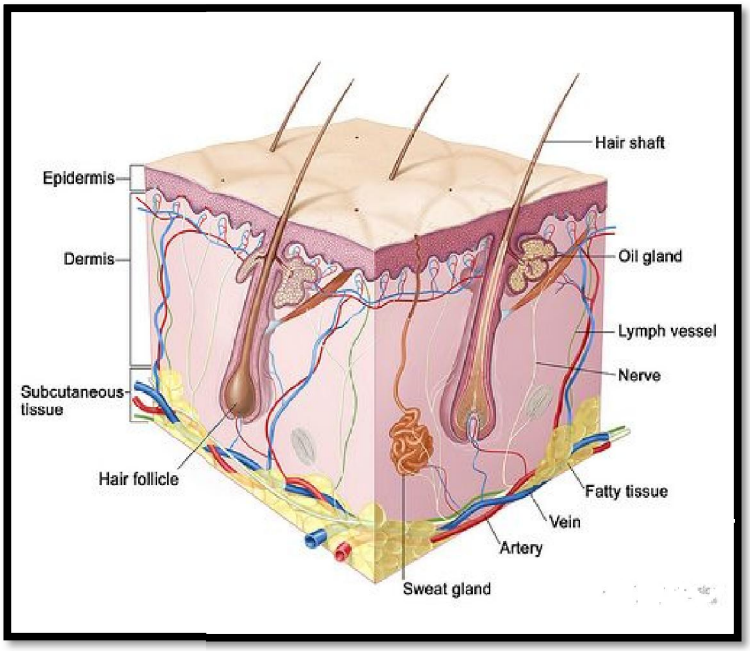

Fig 1: Layers of skin

Wound:

A wound is an injury caused by something from outside the body, and it can affect any part like skin or organs. It means the skin or tissue is broken or damaged, which can also affect how that part works.

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Types of Wounds:
Clean Wound – no germs, safe
Colonized Wound – some germs but not causing harm
Contaminated Wound – germs are present and may cause problems
Infected Wound – germs are causing infection

Healing:
Healing is how the body fixes an injury and tries to make the skin or tissue normal again.
When a part of the body is hurt, the body works to repair the damage and bring things back to normal.
Healing involves many steps inside the body to close the wound, rebuild the tissue, and make it strong again.

Wound healing activity
A wound is when the skin or tissue is cut or broken because of things like accidents, injuries, or surgery.Healing happens in two main ways:
Regeneration (growing new cells)
Repair (fixing the damaged area)

Phases of Wound Healing:
Inflammatory Phase:
Clot formation: When you get a cut, your blood vessels tighten and blood starts to clot (like a plug) to stop bleeding. Platelets release chemicals that help make the blood vessels leaky so healing proteins can reach the wound.
Early and late inflammation: The body sends cells to clean the wound and fight germs.

Proliferative Phase:
New tissue called granulation tissue forms to fill the wound.
Important cells like fibroblasts (which make new tissue) and endothelial cells (which help form new blood vessels) work here.

Maturation Phase:
Starts about 5 to 7 days after the injury.
The new tissue changes into strong scar tissue.
The skin layer on top heals and closes the wound.[3]

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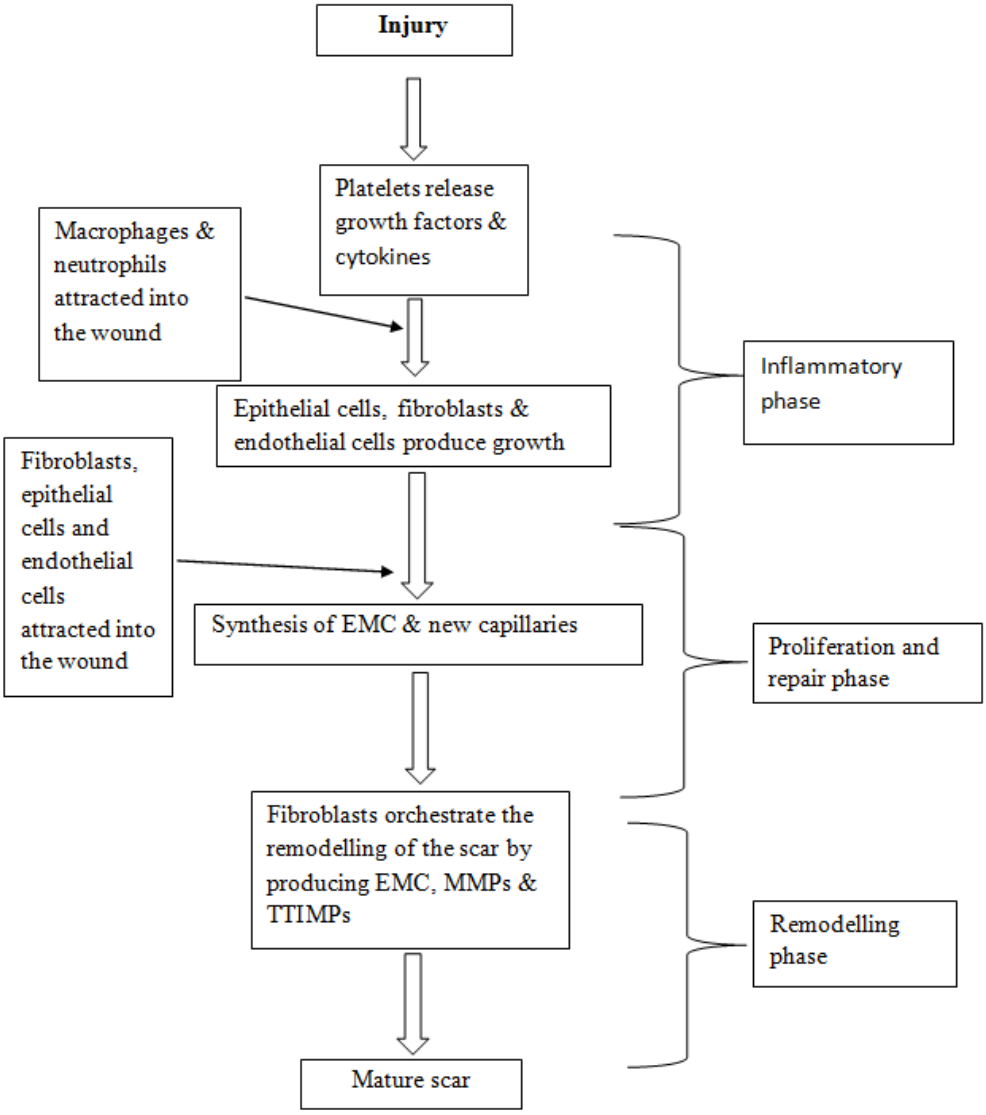
III. MECHANISM ACTION OF WOUND HEALING ACTIVITY



What is a Gel

A gel is a soft, jelly-like medicine. It can be used on the skin, in the mouth, or inside the body. It holds the medicine in a smooth and even way.

Properties of Gels:

Thick but Spreadable: It should not be too runny or too hard.

- Even Mix: The medicine should be spread out evenly in the gel.
- Stays Good: It should not go bad or change over time.
- Sticks Well: It should stay where you put it, like on the skin or inside the mouth.
- Safe to Use: It should not harm your body.
- No Burning or Itching: It should not cause any irritation.
- Easy to Apply: It should be able to put it on easily.

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- Ingredients Work Together: All parts of the gel should mix well.
- Medicine Works Well: The gel should help the medicine work properly.
- See-Through or Not: Some gels are clear, some are not, depending on what's needed.
- Easy to Clean Off: You should be able to wash it off easily.
- Tastes and Smells Okay: If you take it by mouth, it should not taste or smell bad[4].

Ideal properties of gel

Advantages of Gel

- The gelling substance should be safe and not react with other ingredients.
- It should include something to stop germs from growing.
- It shouldn't feel sticky when applied.
- Eye gels must be completely clean and sterile.
- Gels go on smoothly and aren't greasy.
- They are easy to make with medicines.
- They stick well to the skin.
- Can be washed off and are usually safe.
- Stay stable over time.
- Help deliver medicine directly to the problem area quickly.
- Avoid stomach-related side effects by not going through digestion.
- Easy to spread on the skin.

Disadvantages of gel: -

- Not all medicines pass through the skin easily.
- Some people might have allergic reactions.
- Gels may take longer to start working (but effects last longer).
- Extra ingredients can irritate the skin.
- Skin where it's applied needs to be checked for any problems. [5].

IV. DRUG PROFILE

Marigold:

Marigold is a spice originally from India. It has been used for thousands of years in India, China, and Indonesia to add flavour to food and for medicinal purposes. It's a key ingredient in many Indian curries and has been used for over 5000 years.

Taxonomical Classification:

The scientific name of marigold is Tagetes erecta. It is a strong, bushy plant that originally comes from Mexico and warm parts of America. Over time, it has also started growing naturally in tropical countries like India and Bangladesh.

Scientific Name	*Tagetes erecta*
Biological source	Marigold consists of the dried or fresh flowers of Tagetes erecta.
Kingdom	Plantae
Order	Asterales
Family	Asteraceae
Subfamily	Asteroideae
Class	Magnoliopsida
Division	Magnoliophyta
Genus	Tagetes
Species	erect

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Fig 2: Marigold flower

Chemical constituents:

Marigold (Tagetes erecta and Tagetes patula) contains many natural chemicals that give it health benefits, a nice smell, and bright colour. Here are the main ones:

Flavonoids:

Help reduce swelling, fight cancer, and protect the body from damage (antioxidants).

quercetin,
isorhamnetin,
luteolin,
kaempferol

Carotenoids:

Give marigold its yellow-orange colour.
Good for eye health and used in food colouring.

lutein,
zeaxanthin
beta-carotene

Essential Oils:

Give marigold its smell.
Help keep insects away and can be used in perfumes.

ocimene,
limonene,
tagetone,
eugenol,
linalool,
caryophyllene

Triterpenoids:

Help heal wounds and reduce inflammation.

lupeol,
taraxasterol

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Phenolic Compounds:
Act as antioxidants that protect the body from harm.
gallic acid
caffeic acid
chlorogenic acid

Sterols:
Help lower cholesterol and reduce inflammation.
beta-sitosterol

Phytochemical test for marigold extract
Phytochemical screening of marigold leaves extract involves qualitative tests to detect the presence of bioactive compounds contains essential oils, flavonoids, thiophenes, carotenoids, phenolic compounds. Below are the standard phytochemical tests:

Flavonoids:
Shinoda Test:
Principle: Flavonoids react with magnesium and HCl to produce a colored flavonoid complex.
Procedure: Add a few magnesium turnings and a few drops of concentrated HCl to the plant extract.
Observation: The colour changes from orange to yellow typically indicates the presence of flavonoids compound.

Terpenoid test:
Principle: terpenoids react with aceticanhydride and conc.H2SO4 to produce a pale yellow colored complex.
Procedure: Add a few acetic anhydridesand a few drops of concentrated H2SO4 to the plant extract.
Observations: A colour change from orange to pale yellow is weak positive presence of terpenoids

Tannins & Phenols
Lead Acetate Test:
Principle: Flavonoids form a colored precipitate with lead ions.
Procedure: Add a few drops of lead acetate solution to the extract.
Observation: Formation of a yellowish orange precipitate indicates the presence of flavonoids

Saponins
Foam Test:
Principle: Saponins stabilize foam in the presence of sodium bicarbonate.
Procedure: Add 1 ml sodium bicarbonate to 2 ml extract, shake vigorously.
Observation: Stable foam formation indicates the presence of saponins.

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Fig. 3 phytochemical testing

Phytochemical test for marigold extract:

Sr. no	Test	Formation	Inference
1	Shinoda test	Yellow colouration	Presence of flavonoids, tannins, &different types of flavonoids confirm.
2	Salkowski Test	pale yellow	Presence of terpenoids.
3	Lead Acetate Test	yellowish orange	Formation of a yellowish orange precipitate indicates the presence of flavonoids.
4	Foam Test	Stable foam formation	Stable foam formation indicates the presence of saponins.

Aloe vera:

Aloe vera is a plant that has been used for hundreds of years for health, beauty, and skin care. The name comes from Arabic and Latin, meaning "shiny bitter substance" and "true." Long ago, Greek scientists believed it could heal almost anything, and Egyptians called it the "plant of immortality." Today, it is still widely used, especially for treating skin problems.

Fig 4. Aloe vera

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Scientific Name	*Aloe barbadensis miller*
Biological source	Aloe consists of the mucilaginous gel obtained from the leaves of Aloe vera
Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Monocots
Order	Asparagales
Family	Asphodelaceae
Subfamily	Asphodeloideae
Tribe	Aloeae
Genus	Aloe

Active components:

Aloe vera has about 75 active ingredients, including vitamins, enzymes, minerals, sugars, and amino acids. These substances help make it useful for health and skincare. [6].

Neem

Neem, also called *Azadirachta indica* or *Indian lilac,* is a natural herb from the neem tree. Its seeds are used to make extracts, and all parts of the tree—leaves, flowers, seeds, bark, and roots have been used in traditional medicine. Neem helps treat infections, skin problems, fever, and dental issues. It also works well as a natural pesticide and is safe in small amounts for human cells.[7].

Fig.5 Neem

Scientific Name	*Azadirachta indica A. Juss.*
Biological source	Neem consists of various parts of the tree, including the leaves, bark, seeds, and oil, obtained from Azadirachta indica.
Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Eudicot
Subclass	Rosidae
Order	Sapindales
Family	Meliaceae
Genus	Azadirachta
Species	A. indica

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Material and Methodology:

Material: Marigold Collected from Local area market of Shrirampur,in the February.

Chemicals: Carbopol® 934, Propylene glycol, Methyl paraben, Propyl paraben, Glycerin, Triethanolamine, Water.

Equipment: Beaker,Heating Mental, Test tubes,Conical flask,Water bath,Whatman Filter paper,Measuring cylinder,Test tube stand,Stirrer,Storage vials.

Preparation Method

Extracting of leaves extract

Take 30 gm of Marigoldleaves put in beaker and add sufficient amount of 500ml alcohol as a solvent and allow boiling in heating mantle. After 6 hours, filter and collect the extract.

Fig.6 Extracting process

Preparation of Herbal Gel

In a water bath

↓

Put a beaker, add required amount of aloe Vera gel, Marigold extract, and neem extract,

↓

Stirred it continuously up to 10 to 15 minute to form a homogeneous mass of gel [8].

Herbal Gel Formulation

Sr. No	Ingredient	Formulation 1	Formulation 2	Formulation 3
1	Extract	0.12g	0.24g	0.36g
2	Carbopol 934	1.0g	1.0g	1.0g
3	Propylene glycol	10.0ml	10.0ml	10.0ml
4	Methyl paraben	0.2ml	0.2ml	0.2ml

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5	Propyl paraben	0.1ml	0.1ml	0.1ml
6	Glycerin	1.0ml	1.0ml	1.0ml
7	Triethanolamine	q.s	q.s	q.s
8	Water	q.s	q.s	q.s

Evaluation Parameters

Physical appearance: The gel made with Clerodendrum Serratum was checked by looking at its colour, texture, smoothness, and whether any layers separated.

Measurement of pH: To check how acidic or basic the gel is, 1 gram of gel was mixed in 100 ml of water and left for 2 hours. The pH was measured using a digital pH meter three times for accuracy, and the average value was taken.

Spreadability: This test checks how easily the gel spreads. About 2 grams of gel was placed between two glass slides. A 1 kg weight was kept on top for 5 minutes to flatten the gel. Then, a weight of 80 grams was used to pull the top slide. The time it took to move 7.5 cm was recorded. The faster it moves, the better the spreadability. It was calculated using this formula:

$S = M \times L / T$,

where S is spreadability,

M is the applied weight,

L is the distance moved,

T is the time taken.

Stability study: The best gel samples were packed in aluminum tubes and stored at 40°C with 75% humidity for 3 months (as per ICH guidelines). Every month, samples were tested for any changes in look, pH, thickness, spreadability, and ease of squeezing from the tube. [9].

V. RESULT

The present work aimed to the formulation and evaluation of herbal gel. The acacia is a natural gelling agent is used in this formulation. The prepared Formulation was characterized by good or smooth physical appearance, Ph spreadability, Viscosity and skin irritancy.

Fig: 7 Formulation of gel

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Characteristics	Observation / Result
Physical appearance	Smooth
pH	Close to the neutral (6.7)
Colour	Whiteish yellow
Turbidity	Turbid
State	Semi-solid
Odour	Rose like
Spreadability	Good
Skin irritancy	No

VI. CONCLUSION

It can be concluded from the present investigation that proper selection of polymer and drug is prerequisite designing and developing a transdermal drug delivery.

The marigold extract aloevera extract and neem extract are used in the formulation of the herbal gel. These 3 extracts are the main ingredients of this herbal gel formulation.

TheCarbopol 934 is used as gelling agent. Because of this gelling agent the gel is formulated.`

The formulation of gel with Carbopol 934 showed good homogeneity, no skin irritation, good stability and used as a Cosmetic product.

However, theCarbopol 934containing herbal gel proved and it showed the highest percentage of extrudability, good spreadability, and good rheological properties.

This gel is used in the skin for treatment of wound healing.

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