IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Anti-Inflammatory Gel Formulation And Evaluation

Mr. Krishna R. Bhendarkar1, Saurabh V. Prajapati2, Prachi Thakur3, Pranay Rajurkar4,

Ashwini Bhelave5.

1.Guide, Gondia College of Pharmacy, India

2,3,4,5, Students, Gondia College of Pharmacy, Gondia, India

INTRODUCTION

The World Health Organization has already acknowledged the role that herbal medicines play in tribal communities' traditional health care systems. It is simple to obtain medicinal herbs from nature, and it is believed that these natural products have fewer adverse effects (Mishra, 2013; Sharma, 2018). In many tropical and sub-tropical nations, the xerophytes plant Aloe Vera (L.) Bumf. (family: Asphodelaceae) has become naturalized.

WHAT IS INFLAMMATION?

Inflammation plays a very important role in the host response to infection and injury, and is necessary to be in a healthy state against bacterial and viral infections. Knowledge on the anti-inflammatory effects of steroidal alkaloids is very limited. There is currently much interest in the development of new anti-inflammatory agents

from plants used in traditional medicine. Tomato (Solanum lycopersicum) has been used as flavouring agents in food, and beverages and as well as an alternative medicine to treat individuals with cancer, bronchitis, allergies and gout (Kashfi and Rigas, 2005). Because of this evidence, to date, there are no studies on the action of S. lycopersicum especially its leaves, on anti-inflammatory responses.

HOW INFLAMMATION WORKS

higher volume of white blood cells (and the things it makes) in andaround your joints increases irritation, swelling of the joint lining (synovial membrane),and loss of cartilage (the cushions at the end of bones) over time.

Chemicals released from your body's white blood cells enter your blood or the tissues.This increases blood flow to that injury or infection area. It can cause redness and warmth. These chemicals also cause plasma to seep into your tissues, which causes swelling. This protecting mechanism may fire nerves and cause pain.

Aloe Vera is an ethnomedicine used in Trinidad and Tobago for hypertension. The most common folk use of aloe has been to treat burn wounds, and in particular to aid in healing, reduce inflammation, and scar tissue.

Inflammation is our body’s defense response to dangerous stimuli, such as allergens and /Or injury to the tissues; conversely, an uncontrolled inflammatory response is the mainCause of a vast continuum of disorders, including allergies, cardiovascular dysfunctions,Metabolic syndrome, cancer, autoimmune diseases, etc., which impose huge economicBurdens on individual patients and hence society in general.There are many drugs available to control and suppress inflammatory Crises; steroids, nonsteroid anti-inflammatory drugs (NSAIDs), and immunoduppressants Are practical examples; however, all of these medications have adverse effects, whereas we Want to use the minimum effective dose, at maximum efficacy, with minimal adverse Effects. As a result, we will need to use natural anti-inflammatory agents within the Framework of medical therapy to maximize the pharmacological response, without any Adverse side effects.

Herbal medicines are gaining traction as subjects of research in the medical field, and of Course, we should learn about them.Common Anti-Inflammatory Herbs :

Turmeric : Contains curcumin, a potent antioxidant and anti-inflammatory compound.

Ginger : Contains has gingerols which have anti-inflammatory and pain-relieving effects.

Green Tea : Contains polyphenols, especially epigallocatechin-3-gallate (EGCG), which

May mitigate inflammation.

Rosemary : May help mitigate inflammation and improve blood circulatory function.

Garlic : Contains allicin, which has anti-inflammatory and antibacterial effects.

Black Pepper : Increases the absorption of other anti-inflammatory compounds, such as

Curcumin in turmeric.

Chamomile : Has calming and anti-inflammatory properties, especially from tea.

Cinnamon : Contains compounds that have some ability to reduce inflammation and

Improve blood sugar control.

INFLAMMATION TYPE

Autoimmune diseases like rheumatoid arthritis will result in long-term chronic

Inflammation.

Acute inflammation –

This will last only a short time, and goes away in a matter of Hours or days.

This usually occurs as a result of an illness or injury. This is your body sending Inflammatory cells to an area of concern so that you can recover.

Some things that can cause acute inflammation are:

Cuts

Viral illnesses such as the flu or a cold

Bacterial infections such as strep throat.

Chronic Inflammation –

Chronic inflammation can persist for months or even years After the cause of inflammation is no longer present. In some diseases, your body's Defense mechanism – your immune system – initiates inflammation even though there Are no invaders to fight off. This is the case in some forms of arthritis, for example. In These autoimmune diseases, your immune system acts as if regular body tissues were Infected or somehow not normal, resulting in damage.

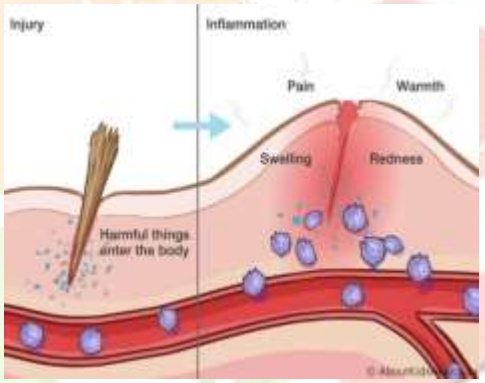

Fig. 1 Inflammation of skin

LITERATURE SURVEY

Diki Prayugo Wibowo, Siti Rahma, et al., [2023]: - Some plants, for example tomato And aloe vera, should be considered for their abundant phytochemical benefits, Especially as they relate to the cosmetics industry. In particular these phytochemicals In their natural form are studied for their antioxidant and anti-aging proprieties from A cosmetic standpoint, as there is a strong demand for the healing of skin.

Gunawan Widjaja and Mohammad Rudiansyah, et al., [2022]: - The tomato leave

Exhibit anti-inflammatory properties and can thus assist in healing skin.

Anita Fajriyani, Icha Nurfirzatulloh, lin Suherti, et al., [2023]: - The tomato can Improve skin health knowledge was developed.

Arup Jyoti, et al. , [2019]: - Glass brings aloe vera that afforded exemplary skin care Properties.

Ajura Amid and Sulwati Semail, et al.,[2011]: In this study, the inflammatory slowing Action of the extract was investigated with the prostaglandin E2 (PGE2)- Immunemetric assay kit for the measurement of PGE2.

Dr. P. S. Variyar , et al.,[2009]: Who is a scientist at the Bhabha Atomic Research Centre in Mumbai India and has examined the anti-inflammatory and wound healing Properties of aloe vera.

J Reuter , A jocher , J1 Stump, et al.,[2008] : Aloe vera is a natural product andSometimes used as a soothing skin care product as beauty products.

Dr. Sudipta Saha, et al., [2006]: A researcher at the University of Dhaka, Bangladesh, studying the anti-inflammatory and antioxidant effects of aloe vera gel.

Dr. Jyothi B. K. L, et al., [2005]: A researcher at the Indian Institute of Science, Bangalore, India, studying the anti-inflammatory and anti-microbial effects of tomato leaf extract.

Dr. Sailaja V. Koduru, et al., [2002]: A researcher at the University of Arkansas, USA, studying the anti-inflammatory and antioxidant effects of tomato leaf extract.

PLANT PROFILE

1. Solanum lycopersicum [Tomato leaves]

Fig. 2 Tomato Leaves

KINGDOM	PLANTAE
DIVISION	SPERMATOPHYTA
FAMILY	SOLANACEAE[Nightshade family]
ORDER	SOLANALES
GENUS	SOLANUM
SPECIES	SOLANUM LYCOPERSICUM
BOTANICAL NAME	SOLANUM LYCOPERSICUM L.
SYNONYMS	LYCOPERSICON ESCULENTUM
REGION	Native to South America, specifically Peru

Description

The tomato plant, Solanum lycopersicum, is a dicotyledonous plant in the family Solanaceae that is widely grown for its edible fruits and is an excellent source of vitamins And anti-oxidant. In addition, the leaves exhibit anti-oxidant and anti-inflammatory Properties that is the herbal component used in the preparation of several medicinal Products.

Taxonomical Classification:

Solanum lycopersicum is in the nightshade family (Solanaceae), which includes potatoes, Eggplants, and peppers.

- Origins:

Tomatoes are native to Peru from where it spread globally with the advent of Spanish Colonization.

- Growth Habit:

Tomatoes are generally grown as annuals, but in frost-free climates, they can grow as

Perennials. They can attain a height of 3 to 10 feet tall and a width of 1 to 4 feet.

Plant Characteristics:

- Leaves : Tomato has compound leaves with oval-shaped leaflets with serrated edges.
- Stems : Tomato stems are square to round and have trichomes (the hairs on its Surface).
- Flowers : The flowers are yellow, with five petals, and are usually self-fertilizing.
- Fruits : The fruit is classified as a berry and can be flattened, globular, or oblate and

When ripe, will be green, red, pink, orange, or yellow.

- Seeds : The seeds are flattened, oblong, and light brown and have hairs on them.

Cultivation

Tomatoes are a crop that is grown in warm weather, specifically for its edible fruits, in Vegetable gardens.

- Uses

Edibles: Tomatoes are a well eaten vegetable, that can be eaten raw in salads, cooked, or Used as a secondary ingredient in many other recipes.

Processing: A large part of the tomato crop is sold processed in products such as canned Tomatoes, tomato juice, ketchup, tomato puree, tomato paste.

Nutritional Value: Tomatoes are a source of vitamin C, potassium, folate, and vitamin K, And are a food source of antioxidants such as lycopene.

- Toxicity

The leaves, stems, and green unripe fruits contain small quantities of the alkaloid toxins (tomatine and solanine). These toxins are poisonous and toxic to humans, cats, dogs, and Horses.

2. ALOEVERA [Aloe barbadensis Miller]

Fig.3 Alovera

DIVISION	TRACHEOPHYTA
FAMILY	ASPHODELACEAE
ORDER	ASPARAGALES
GENUS	ALOE
SPECIES	ALOE VERA
BOTANICAL NAME	ALOE BARBADENSIS MILLER
SYNONYMS	ALOE BARBADENSIS
REGION	Native To The South-East Arabian Peninsula

Description

Aloe vera is a succulent plant characterized by its succulent, thick leaves and its use for Topical medicinal purposes and in cosmetics. Aloe vera is a perennial plant, because it can Live more than two years, and can reach 4 feet in height. The leaves range in color from Grey to green, with some leaves having white spots, and have sharp, pink-medial spines Along the edges.

Leaves:

The leaves are thick, fleshy, and bondage-shaped and can reach 36 inches long. It is a Source of the clear thick gel that has been used in many products.

Flowers:

Aloe vera has yellow, tubular flowers that cluster onto a stem.

Gel:

The gel is inside of the leaves and is a well-known ingredient in endless products such as Lotions, creams, and supplements.

Growth:

The plant can reach heights of up to four feet and is often found in tropical and

Subtropical environments.

Uses:

Aloe vera can be used for a variety of reasons, including treating minor burns and cuts, Skin moisturizer, and assisting with wound healing.

Properties:

Aloe vera has antioxidant and antibacterial properties and has a variety of macro and Micro-molecules.

Aim & Objective

Aim:
To develop and evaluate Polyherbal Anti-inflammatory Gel containing of the Solanum Lycopersicum potentially anti-inflammatory plants for treatment of inflammation, with An aim to reduce Inflammation & Irritation Hydrate & repair skin Stability & Shelf Life Consistency & pH A Safe & More Effective Alternative.

Objective:
The purpose of this preparatory work is to develop a topical anti-inflammatory gel on
The basis of Aloe Vera, Tomato Leaves Extracts and Carbopol 940.
The formulation will aim to do the following:

- Reduce Inflammation & Irritation
- Hydrate & Repair skin
- Stability & Shelf Life
- Consistency & pH
- A Safe & More Effective Alternative.

METHODOLOGY

METHODS AND MATERIALS:

A. Collection and Drying of Plant Material: The leaf material was collected,

Coarsely ground and then put into a well-stoppered container. The dried Material of Solanum Lycopersicum was then used for further work.

MATERIALS:

Mature plants of leucas aspera were used for this preparation and were acquired From Gondia city 2025. Analytical balance was used for weighing Solanum Lycopersicum powder. Sieve was used to separate fine paricles from Solanum Lycopersicum powder. Heating Mantle was used for heating solution during Soxhlet extraction time. Soxhlet chamber was used for extraction process. Round bottom flask and measuring cylinder were used for measureing solvent.

Solvent system:- METHANOL

Fig.4 Soxhlet Extraction

How it works:

1. Sample Preparation:
   A solid sample is placed in a porous thimble (typically cellulose) in the Soxhlet Extractor.

2. Heating and Vaporization:
   A solvent, usually an organic solvent such as ethanol or hexane, is placed in a Flask and heated. The solvent vaporizes and condenses in a condenser.

Condensed solvent drips onto the material in the thimble

3. Extraction:
   The solvent dissolves the target compounds from the sample.

4. Siphoning and Re-initiation:
   As the solvent chamber becomes filled with solvent-compound mixture, the solvent is siphoned into the flask. This process is repeated; thus, allowing the fresh solvent to be in constant contact with the sample.

5. Solvent Recovery:
   When the extraction is complete, the solvent is recovered from the flask via distillation.

Fig. 5 Extract

Contents:

Aloe Vera Extract (or gel) – 30-40%
Tomato Leaves Extract – 10-15%
Methylparaben – 0.1-0.5%
Carbopol 940 (gelling agent) – 2mg
Triethanolamine (TEA) – To adjust pH (probably 5-7%)
Distilled Water – The rest to make up the final volume (qs)

PROCEDURE:

1. Prepare the Carbopol Gel Base:
   Disperse the Carbopol 940 into distilled water that is (about 60-70% of your final Volume). Mix slowly to avoid clumping, and to ensure that the Carbopol is fully hydrated. Hydrate approximately 15-30 minutes.

2. Mixing Aloe Vera and Tomato Extracts:
   After the Carbopol Gel base was created, add the Aloe Vera extract (or gel) and the Tomato Leaf extract to the mixture. Mix the Aloe Vera and Tomato Leaf extracts into the Mixture gently so you don't create too many bubbles and are able to mix evenly.

3. Mixing Methylparaben:
   Mix the methylparaben with a very small volume of water (approximately 0.1-0.5%) in a Separate cup before adding to the mixture. It is a preservative and will help prevent any Microbial growth in the preparation.

4. Using Triethanolamine (TEA) to balance the pH:
   You will now need to add the triethanolamine (TEA) to the mixture little by little, without Causing bubbles. You will want to adjust the pH to between pH 5.5 and 7. Your Carbopol Gel will only become thick when your pH has reached the designated range, so be aware, As soon as your pH is balanced your Carbopol gel will become thicker. Add TEA drop by Drop and check the viscosity.

5. Mixing Everything Together:
   You will want to mix everything together until a smooth uniform gel-like consistency Occurs. Make sure that all ingredients are mixed evenly, and there are not any lumps in the Mixture.

6. Containerizing the Product:
   Once completed the gel can be transferred to clean containers. If needed, you may need to Store in an air-tight jar or tube to preclude contamination.

   Storage
   - Store in a clean, airtight container.
   - Keep in a cool, dry place.

Usage

You can apply this anti-inflammatory gel to aggravated or inflamed areas of the skin. Aloe Vera and Tomato Leaf Extract will reduce the inflammation and soothe the areas, and the gel will help to hydrate and keep the skin moist.

EXPERIMENTAL WORK

Once you have developed your gel, it is time to test whether your gel has anti-Inflammatory effects. This can be approached in a number of ways:

1. In vitro Anti-Inflammatory Testing An in vitro assay can be used to evaluate the anti-Inflammatory properties of your formulation.
2. inhibition or pro-inflammatory cytokine from cultured responses to LPS exposure (to Stimulate inflammation).

Procedure

- Culture human skin cells (i.e. keratinocytes or fibroblasts) in appropriate media.
- Exposed the cells to a pro-inflammatory agent, such as lipopolysaccharide (LPS) to Induce inflammation.
- Treat the cells with your gel formulation (with variable concentrations) for a set time, Such as 24 hours.
- Once treatment is complete, measure the inflammatory end points (inflammatory Markers such as prostaglandins (via COX-2 activity) or cytokines – such as TNF-α, IL-6, etc.) with ELISA kits or PCR.
- Finally, if you have access to ex-vivo human skin specimens, you may also conduct a Skin irritation test, which would offer a better insight regarding how the gel could Perform directly on skin tissue.

EVALUATION PARAMETERS

- Homogeneity:

The developed gel was tested for homogeneity by visual inspection after solidification of

The gel in the container. It was tested for appearance and presence of aggregates.

- Grittiness:

The formulation was checked microscopically for particles.

- Measurement of pH:

The pH of the formulation was measured using a digital pH meter. One gram of gel was Dissolved in 100 milliliters of distilled water and stored for two hours. The pH Measurement was taken in triplicate, and the standard deviation was calculated. The pH Of the gel should be close to the normal pH of the skin to prevent irritation.

- Viscosity study:

The viscosity of the prepared gel was measured using a Brookfield viscometer. The gels Were rotated at 2.5 rpm with spindle no. 64, and the corresponding dial reading was Recorded.

- Spreadability study:

One key criterion for an ideal gel is good spreadability. This term refers to how well the Gel spreads when applied to the skin or the affected area. The effectiveness of a formulation relies on its spreadability value. We Measured the spreadability of the gel by checking the spreading diameter of 1 g of gel Between two horizontal plates, each measuring 20 cm by 20 cm, after one minute. A Standard weight of 125 g was placed on the upper plate to evaluate spreadability. We Measured the diameter of the spread circle in centimeters, and the final result is the Average of three measurements.

- Extrudability study:

This study of gel formulation measures the force or pressure needed to push the gel out of A tube. A larger amount of gel extruded indicates better extrudability. This method relies On the percentage of gel that comes out of the collapsible tube when finger pressure is Applied.

RESULT & DISCUSSION

The herbal anti-inflammatory gel was made by mixing the extract of Solanum Lycopersicum into an aloe vera gel base. After finishing the gel, we evaluated it by Conducting various tests and checking its physicochemical properties like color, odor, pH, And consistency. The gel provided a smooth texture when applied. We also tested the

Formulation for its anti-inflammatory effectiveness against inflammation.

- CHEMICAL TESTS:

SR.NO	NAME OF TEST	INFERENCE
1	SAPONIN	POSITIVE
2	TERPINOID	NEGETIVE
3	TANNIN	POSITIVE
4	HEMOLYSIS TEST	POSITIVE

RESULTS OF EVALUATION PARAMETERS:-

- The prepared gel was found to be uniform in nature.
- It has a smooth texture with no gritty particles.
- The pH of the gel measures between 5.5 and 7.
- The formulation is viscous.
- The gel spreads well and easily covers a surface.

CONCLUSION

1. It has been established that combinations of these natural substances provide us with A herbal product that helps in treating skin inflammation and irritation.
2. The herbal product also has been observed to have good spreadability and Homogeneity.
3. The gel provides the hydration and smooth texture to the skin.
4. The gel has no side effects as it contains only natural ingredients.
5. The test done for the product showed a positive result that could eventually be flexible For topical use.
6. No signs of irritation or adverse reactions were expressed, which means that it is good For skin compatibility.
7. The product can be used by world populations of all ages.
8. The pH of the gels will usually be in the range considered to be safe for topical Application, typically near around pH 7.
9. The gels are worked as low irritant and non-greasy, so it feels good.

REFERENCE

1. Nichols, M.; Townsend, N.; Scarborough, P.; Rayner, M.Cardiovascular Disease in Europe 2014: An Update on the Epidemiology. Eur. Heart J. 2014, 35, 2950-2959.
2. Wu, J.; Xia, S.; Kalionis, B.; Wan, W.; Sun, T. Oxidative Stress and Inflammation in Cardiovascular Aging. BioMed. Res. Int. 2014, 2014, 1-13.
3. Ungvari, Z.; Orosz, Z.; Labinskyy, N.; Rivera, A.; Xiangmin, Z.; Smith, K.; Csiszar, A. Mitochondrial H_2O2 Production and Endothelial NF-kB Activation in Aged Rat Arteries. Am. J. Physiol.Heart Circ. Physiol. 2007, 293, H37-H47.
4. S.; Bruce, I.N. Atherosclerosis in Rheumatoid Arthritis: Is It All about Inflammation Nat. Rev. Rheumatol. 2015, 11, 390-400.
5. Lugrin, J.; Rosenblatt-Velin, N.; Parapanov, R.; Liaudet, L. Oxidative Stress and Inflammatory Processes. Biol. Chem., 2014, 395, 203-230.
6. Kay, J.; Thadhani, E.; Samson, L.; Engelward, B. DNA Damage, Mutations and Cancer Induced by Inflammation. DNA Repair, 2019, 83, 102673.
7. Alotaibi, B.; Ijaz, M.; Buabeid, M.; Kharaba, Z.J.; Yaseen, H.S.; Murtaza, G. A Review on Therapeutic and Safe Uses of Plant-Based Polyphenolic Compounds in Cardiovascular Diseases. Drug Des. Devel. Ther., 2021, 15, 4713-4732.
8. Xu, W.; Lu, H.; Yuan, Y.; Deng, Z.; Zheng, L.; Li, H. Antioxidant and Anti-Inflammatory Activities of Flavonoids from Propolis through Nrf2 and NF-KB Pathways. Foods, 2022, 11, 2.
9. Imran, M.; Ghorat, F.; Ul-Iaq, L.; Ur-Rehman, 1,1;(Ash q Marant F.; Heydari M.; Shariati M.A.; Okuskhanova E.; Yessimbekov Z.; Thiruvenqadam M.; et al. Lycopene As A Natural Celebrated Cell-Protective Antioxidant Of Frontline Debt Friendly and Oxidative Stress-Responsible Diseases In Humans. Antioxidants 2020, 9, 706.
10. Cha, J.H.; Kim, W.K.; Ha, A.W.; Kim, M.H.; Chang, M.J. Anti-Inflammatory Effect Of Lycopene in SW480 Human Colorectal Cancer Cells. Nutr Res Pract 2017, 11, 90.
11. Yin, Y., Zheng, Z., Jiang, Z. The Effects of Lycopene on Glycolipid Metabolism in Type 2 Diabetic Rats. Biomed. Pharmacother. 2019, 109, 2070-2077.
12. Das, K.K., Razzaghi-Asl, N., Tikare, S.N., Di Santo, R., Costi, R., Messore, A., Pescatori, L., Crucitti, G.C., Jargar, J.G., Dhundasi, S.A., et al. Hypoglycemic Activity Of Curcumin Synthetic Analogs in Alloxan-Induced Diabetic Rats. J. Enzyme Inhib. Med. Chem. 2016, 31, 99-105.
13. Zhang, X., Zhou, Q., Qi, Y.; Chen, X.,Deng, J., Zhang, Y., Li, R., Fan, J. TheEffect of Tomato and Lycopene onClinical Characteristics and MolecularMarkers of UV-Induced SkinDeterioration: A Systematic Review andMeta-Analysis of Intervention Trials. Crit.Rev. Food Sci. Nutr. 2023, 1-20.
14. Chen, M.-L., Lin, Y.-H., Yang, C.-M.; Hu, M.-L. Lycopene Inhibits Angiogenesis Both in Vitro and in Vivo by Inhibiting MMP-2/uPA System through VEGFR2- Mediated PI3K-Akt and ERK/P38 Signaling Pathways. Mol. Nutr. Food Res. 2012, 56, 889-899.
15. Khongthaw, B.; Dulta, K.; Chauhan, P.K.; Kumat, V.; Ighalo, J.O. Lycopene: A Therapeutic Strategy against Coronavirus Disease 19 (COVID-19). Inflammopharmacologu 2022, 30, 1955-1976.