Formulation and Evaluation of Aloe-Vera Herbal Hydrogel

Karan. D. Atpadkar*, Akanksha. N. Mote, Santoshkumar. A. Shewale, Adesh. V. Pandhare, Vishal, H, Pawar

ABSTRACT:

The display study deals with the advancement and characterization of Aloe Vera hydrogel planning utilizing the inward portion of aloe vera leaf, Carbopol 934, polyethylene glycol 400, triethanolamine, glycerine, methylparaben, orange oil, refined water aloe vera mash is changed over into a fluid utilizing the blender and hydrogel is arranged by a basic dissolving strategy of other fixings in a particular way. Nine details were created which contrast in the ratio of hydrogel-forming polymer. All details were assessed for physical evaluation, pH, Spreadability, % moisture substance, antibacterial action, washability, and consistency. The definition F6 was chosen as the optimized detailing based on the assessment parameter. based on the assessment consider, it can be concluded that Aloe vera hydrogel is a secure and compelling treatment alternative utilized to oversee skin-related diseases.

INTRODUCTION:

One critical restorative plant is aloe vera. It is more in request and sold in worldwide restorative medicine markets as a source of "aloin" (4.5 to 25 percent) and as a enhancing fluid [1]. Therapeutic experts have customarily utilized salves containing aloe vera to treat serious thermal wounds counting frostbite and burns. Aloe vera gels are utilized by dental practitioners to treat gum aggravation and swelling. Dermatologists utilize aloe vera items to treat skin break out, whereas optometrists discover them valuable for decreasing aggravation in the eyes. Proficient sports coaches utilize aloe vera to recuperate their athletes' rankles, skin scraped spots, and sprains. Since aloe vera has such positive effects, corrective brands incorporate it in their skincare and cosmetics items. Moreover, it's for marketing. Aloe vera tea weakened with nectar is claimed to give alleviation from diabetes, ulcers, joint pain, and other sicknesses. This antiquated herb is getting to be more and more well-known due to its numerous employments and positive benefits [2, 3]. Aloe vera is a lasting juicy plant that can withstand dryness and is a part of the Liliaceae family of lilies, which has a long history of restorative employments. The plant has unbending, lance-shaped, grey-green takes off with a centre mucilaginous mash that contains a straightforward gel.

Clinical examinations have appeared that the aloe vera leaf's skin and gel contain the lion's share of the plant's pharmacologically dynamic components. It has been illustrated that these dynamic components have pain relieving and anti-inflammatory properties Of the 300 (and more) sorts of aloe vera found around the world, the real aloe vera plant is known as Aloe barbadense Miller, some of the time alluded to as the

Curacao aloe, and is the most medicinally compelling [4,5]. Due to its broad utilization in restorative things, aloe vera is presently well-known to the larger part of individuals in the UK. The plant has been alluded to as "the wand of paradise," "heaven's favouring," and "the noiseless healer" over the a long time [3,4]. There are a few aloe vera home grown details on the advertise in the shape of creams, gels, confront arrangements, moisturizers, and other items; be that as it may, the sum of aloe vera extract and home grown components in these definitions is or maybe little. Moreover, these definitions seem incorporate perilous substances like surfactants. The current ponder centres on making an aloe vera restorative home grown hydrogel detailing, or corrective facial, with a bigger concentration of home grown and aloe vera leaf extract [5].

ROUTE OF ADMINISTRATION:

The organization of medicine through the skin to treat or remedy skin conditions is known as topical medicate conveyance. When elective strategies of organization are unreasonable or for localized skin ailments such as contagious diseases, these topical pharmaceutical delivery gadgets are regularly used. It can superior retain substances since they can go more profound into the skin.

There are no benefits to topical organization over conventional measurements shapes. Since of their bilayer shape and substance, they are for the most part thought to be less harmful and more viable than conventional definitions. Topical arrangements diminish irritability and halt the drug's liver handling, which increments the drug's bioavailability. Topical solutions work promptly at the area of the activity. A gel is a three-dimensional arrange of basic components that comprises of two components that are cross-linked. The auxiliary components of the gel arrange might be either natural macromolecules, for the most part polymers, or inorganic particles.

Topical Medicate Conveyance System

A topical delivery framework is characterized as the substance that carries a particular medicate into contact with and through the skin. The challenge to topical medicate delivery is the transport over the skin barrier.

Topical delivery incorporates two fundamental sorts of products:

- An outside topical is connected to the beset locale by spreading, showering, or by a few other strategy on the cutaneous tissues.
- Inside topicals with local activity that are managed orally, vaginally, or to the tissues of the anorectum.

Most of the time, topical medications are utilized to create localized impacts at the application location by the drug's entrance into the mucous layers or fundamental layers of skin.

Advantages of topical sedate conveyance frameworks [6, 7]

1. Avoid utilizing the first-pass metabolic pathway.

2. Down to earth and basic to use.

3. Direct clear of the dangers and hassles related with intravenous treatment as well as different absorption circumstances such as pH shifts, the nearness of proteins, and stomach purging time.

4. More accurately regulate medicine to a assigned location.

Disadvantages of topical medicate conveyance systems:

1.. The pharmaceutical or its excipients may cause dermatitis or skin irritation.

2. Certain drugs do not pass through the skin well.

3. More prominent molecule sizes make it more troublesome for drugs to enter the body through the skin.

4. Probability of allergic responses.

5. Can as it were be utilized for drugs whose activities depend on greatly moo plasma concentrations.

6. Drugs that cause skin bothering or affectability ought to not be taken through this method. [8]

FACTORS Influencing TOPICAL Absorption OF Medicate [9]

The variables that influence the topical assimilation of drugs are as follows

- Physiological factors:
- Skin thickness
- Lipid content.
- Density of hair follicles.
- Density of sweat glands.
- Skin pH
- Blood flow.
- Hydration of skin.
- irritation of skin
- Physiochemical factors:
- Atomic weight

- Parcel coefficient
-

ANATOMY OF SKIN [10, 11]

Human skin comprises three commonly dependent tissues:

1) The dermis of connective tissues underneath

2) the stratified, vascular, and cellular "epidermis"

3) Hypodermis

1. Epidermis:

The epidermis of the skin is shaped by stratified epithelium, which is made up of 5 layers:

1. Stratum corneum.

2. Stratum lucidum

3. Stratum granulosum

4. Stratum spinosum and

5. Stratum germinativum

The absence of blood vessels in the epidermis is its most significant characteristic.

The dermal capillaries are what supply the food. The highest layer of skin is called the epidermis, and it is made up of stratified, squamous, keratinizing epithelium. Keratinocytes, which are mindful for the skin's barrier properties, have a rate greater than 90%.

2. Dermis:

The thick layer of sinewy and flexible tissue that makes up the dermis skin's following layer gives it quality and adaptability. It is for the most part composed of collagen, elastin, and fibrillin. Blood arteries, sweat organs, oil organs, hair follicles, and nerve endings are all found in the dermis. The dermis is a vascularized connective tissue wealthy in collagen and mucopolysaccharides that are collectively referred to as the ground substance.

3. Hypodermis: The epidermis is the skin's deepest layer. It serves as the layer of contact between the skin and the body's fundamental tissues, counting the bones and muscles. Hair follicles, sweat organs, and sebaceous organs start in the dermis and are encased in the epidermis.

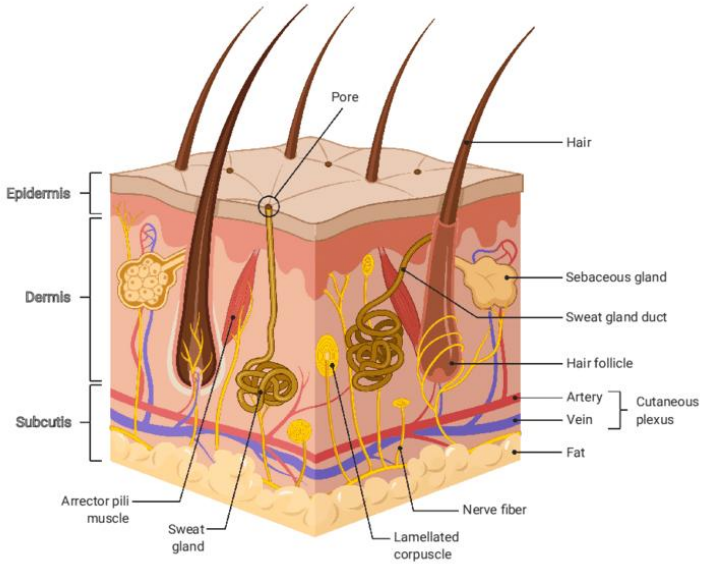

Fig 1

4. HYDROGEL [12]:

A organize of insoluble polymer chains, hydrogel, some of the time called aqua gel, is some of the time watched as a colloidal gel in which water serves as the scattering medium. Characteristic or manufactured polymers that are superabsorbent-able to store more than 99% of water-are utilized to make hydrogels. Hydrogels too have an elasticity exceptionally comparable to that of genuine tissue since of their tall water content.

Properties of Hydrogels [13]:

1. The gelling operator should in a perfect world be secure, inert, and incapable to respond with other fixings in the formulation.

2. An fitting antimicrobial operator ought to be present.

3. The topical hydrogel can't have any stickiness.

4. Sterile ophthalmic gel is required

5. They show the strong state's mechanical properties.

6. Each component remains consistent all through the system.

7. Since of the solid partiality between the scattered stage and the fluid medium, the gels do not readily settle and remain uniform when standing.

Characteristics of hydrogels:

1. Swelling

Gels have the capacity to extend and retain fluid, expanding in volume. One may consider this to be the to begin with organize of disintegration. Gel-solvent intuitive take the part of gel-gel intelligent when the dissolvable penetrates the gel lattice. The larger part of the time, limited swelling is caused by a certain sum of crosslinking in the gel network that hinders total breakdown. When the dissolvable combination has a solubility parameter comparative to the gallant's, this sort of gel swells significantly.

2. Syneresis

Many gel frameworks contract when cleared out in a standing position. As the interstitial fluid is communicated, it accumulates close the gel's surface. This wonder, known as syneresis, has moreover been seen in organogels and inorganic hydrogels. It is not select to natural hydrogels. Generally talking, syneresis heighten as polymer concentration drops.

3. Aging

Usually, colloidal frameworks total gradually on their possess. The term "maturing" alludes to this prepare. Maturing causes a thick arrange of the gelling operator Structure to slowly collect in gels. The organize made by the gelling operator particles interfacing gives a gel its solidness. The

characteristics of the gel and the network's structure are decided by the kind of drive and molecule included in the connections.

4. Rheology

Pseudoplastic arrangements, or those containing flocculated strong dispersion and gelling specialist arrangements, show non-Newtonian stream conduct, which is characterized by a drop in consistency with an increment in shear rate. When shear stretch is connected, the powerless structure of inorganic particles scattered in water is broken up by the disintegration of inter-particle association, appearing a more grounded slant to stream. Moreover, when shear push is connected to macromolecules, it adjusts the particles in the heading of pressure, fixing them out and decreasing stream resistance.

Uses of Hydrogels:

1. As delivery frameworks for orally managed drugs.

2. For topical drugs connected specifically to the skin, mucous layer, or the eye.

3. As long-acting shapes of medicate infused intramuscularly or embedded into the body.

4. As covers in tablet granulation, defensive colloids in suspensions, and thickeners in verbal fluid and suppository bases.

5. In makeup like shampoos, scent items, dentifrices, and skin and hair care preparations.

6. Oil for catheter[14].

Advantages of hydrogels:

1. Their tall water substance gives them a degree of flexibility that is nearly indistinguishable to that of genuine tissue.

2. Opportune discharge of supplements or medications.

3. They may be infused and are both biocompatible and biodegradable.

4. Hydrogels can distinguish varieties in pH, temperature, or metabolite concentration and discharge their stack in reaction to these changes.

5. Hydrogels are moreover effectively modifiable and have solid transport

Disadvantages of hydrogels:

1. Negligible mechanical potency.

2. Due to their non-adherent nature, they may require supplementary dressings to keep them in put. The development of the hatchlings can also cause discomfort.

3. Difficult to fill up with foods and/or medications [15,16].

Fig 2

Aloe vera

Kingdom	Plantae
Class	Monocots
Order	Asparagus
Family	Asphodelaceae
Subfamily	Asphodeloideae
Genus	Aloe
Species	A. vera

Table 1

Around the world, it develops wild in tropical regions and is developed for culinary and medicinal purposes. Aloe is an decorative plant that may be developed effectively interior in a container [17]

It may be found in a wide run of customer products, counting as drinks, moisturizers for the skin, cosmetics, and treatments for sunburns and gentle burns. The security or viability of aloe vera extricates as a restorative or therapeutic operator is not well backed by logical investigate. inquire about that find prove in support are frequently negated by another research.

Description:

Aloe vera is a plant with brief or no stems that can reach statures of 60-100 cm (24-39 in) and spreads by offsets. Thick and substantial, the takes off run in colour from green to grey-green, and certain sorts have white dots on the upper and foot surfaces of the stems. The leaf's edge highlights tiny white teeth and is serrated. Mid year produces spikes up to 90 cm (35 in) tall with pendulous blossoms that have a yellow tubular corolla that is 1-2 cm (0.8-1.2 in) long. Aloe vera produces arbuscular mycorrhiza, a advantageous relationship with other Aloe species that improves the plant's get to to mineral supplements in the soil.

Phytochemicals found in aloe vera clears out, counting acetylated mannans, poly mannans, anthrones, anthraquinones, C-glycosides, and other anthraquinones counting emodin, are being examined for potential bioactivities.

Collection and cultivation:

You may develop aloe vera as a decorative plant. Developing aloe vera as a enriching plant has ended up commonplace. The species is well-liked by modern cultivators for its captivating shape, sprouts, and succulence in expansion to its potential restorative employments. Since of its succulence, this plant may flourish in locales with small normal precipitation, which makes it idealize for low-water gardens such as

rockeries. [18] The species is tough in zones 8-11 and is comparatively resistant to most insect bugs, in any case, it may end up less solid due to spider bugs, coarse bugs, scale insects, and aphid species. Be that as it may, the species is not tolerant of truly overwhelming ice or snow. The plant needs well-drained, sandy preparing in pots...

The utilize of a good-quality commercial engendering blend or packaged "cacti and juicy blend" soil and shinning, sunny circumstances, in any case, aloe plants can burn in over the top daylight or shrivel if the water in the holder is not depleted is exhorted as they empower proper waste Since they are permeable, terra cotta pots are the best choice. Sometime recently rewatering, pruned plants ought to be permitted to dry completely. Aloes in pots can get packed with "pups" that develop out from the edges of the "mother plant". It is fitting to keep the species inside or in warmed glasshouses in places that get ice or snow. Aloe vera is created agriculturally on a big scale in Australia, Bangladesh, Cuba, an Dominican Republic, China, Mexico, India, Jamaica, Kenya, Tanzania, and South Africa.

Uses:

Benefits For Skin

1. Prevents Signs of Aging

2. Moisturizes Skin

3. Decreases Acne and Makes a difference Help Blemishes

4. Mends Outside Wounds and Insect bites.

Benefits For Hair

1. Advances Hair Growth

2. Decreases Dandruff

3. Keeps up pH Adjust of The Scalp

4. Conditions Hair

Benefits For Health

1) Diminishes Inflammation

2) Eases Acid reflux and Acid Reflux

3) Decreases Cholesterol and Controls Blood Sugar

4) Keeps up Verbal Health

5) Builds Immunity

6) Brings down Chance of Cancer

7) Makes a difference In Treating Haemorrhoids

Benefits For Skin

Numerous supplements, counting glycerine, sodium sense of taste, sodium carbonate, sodium palm kernelate, sorbitol, and others, are abundant in aloe vera cleanser and gel. These are useful to the skin since they feed it from the interior out, giving you healthy-looking skin.

Fig 3: Fresh Aloe Vera Pulp

The excipients utilized are as follows:

1] Carbopol -934 [19]

1. Synonym: Acrypol, acrylic corrosive polymer, polyacrylic acid

2. Molecular formula: C3H402

3. Molecular weight: 70.02 g/mol

4. Characteristics:

• Excellent freeze-thaw and high-temperature steadiness at moo concentrations in oil-in-water emulsions.

• Fabulous stability at tall viscosity.

Other properties:

Light skin feel.

Pharmaceutical application: The promptly water swellable Carbopol polymers are utilized in a different extend of pharmaceutical applications to give Controlled discharge in tablets, Bio attachment on buccal, ophthalmic, intestinal, nasal, vaginal, and rectal applications.

2] Methyl Paraben:

1. Synonym: 4 hydroxybenzoic corrosive methyl ester, methyl chemo sept.

2. Molecular formula: C8H803

3. Molecular weight: 153.15

4. Chemical Title: Methylparaben

5. Characteristics:

• Methylparaben happens as colourless gems or a white crystalline powder.

• It is unscented or nearly scentless and has a slight burning taste.

6. Other properties: • Methylparaben is a colourless crystalline powder that is unscented or has a black out characteristic Odor dissolvable and a slight burning taste.

Pharmaceutical Application:

I.. For more than 50 a long time, methylparaben has been used as a additive in the nourishment, restorative, and pharmaceutical sectors

2. Furthermore, it happens actually in nourishments with antibacterial properties like blueberries

3] Triethanolamine:

1. Synonym: Triethylamine, trolamine, trihydroxy triethylamine

2. Molecular formula: C6H15NO3

3. Molecular weight: 149.19

4. Chemical title: Trolamine

5. Characteristics:

1. Triethanolamine, or TEA is a thick natural compound that is both a tertiary amine and triol.

2. Triethanolamine responds brutally with a solid oxidizing agent.

6. Other Properties: The compound is utilized to make surfactants in mechanical and makeup as a pH agent for skin and hair conditioning items as well as sunscreen lotions,

Pharmaceutical Application:

1. Triethanolamine is considered secure for utilize in both skin and hair care products.

2. Many concerns are raised around triethanolamine toxicity and its security as a skincare ingredient

4] Propylene Glycol 400:

1. Synonym: 1,2-dihydroxypropane, 1,2-propanediol, methyl glycol, and trimethyl glycol.

2. Molecular formula: C3H802.

3. Molecular weight: 380-420 g/mol

4. Characteristics:

1) Propylene glycol is a clear, colourless, slightly syrupy liquid at room temperature.

2. It may exist in air in the vapor form, although propylene glycol must be heated or briskly.

3. Shaken to produce a vapour.

Other Properties:

a) Propylene Glycol is a viscous, stable, hygroscopic liquid.

b) It is essentially colourless and has a slight Odor and a very slight acid.

Pharmaceutical Applications:

1. This medication is used to relieve dry, irritated eyes.

2. Common causes for dry eyes include wind, sun, heating/air conditioning, computer use/reading, and certain medications.

LIST OF EQUIPMENT:

Sr.no	Equipment
1	Brookfield apparatus
2	pH Meter
3	Homogenizer
4	Incubator
5	Autoclave
6	Desiccator
7	Ultrasonicator

Table 2

EXPERIMENTAL WORK:

Material and Methods [20,21]

Collection of plant material

Aloe vera was collected from the local area of Karad Maharashtra in the month of May 2024.

Preparation of extract:

The fresh aloe vera pulp is extracted from the aloe vera then aloe vera pulp is converted into a liquid by a mixer.

Method of preparation:

1. A weighed amount of Carbopol 934 was soaked for one day in 10 ml distilled water

2. Carbopol 934 was homogenized in homogenizer.

3. Mix other ingredients [Aloe vera extract, Propylene glycol 400, glycerine, methylparaben, water] properly in another beaker.

4. Then add the above mixture in homogenized Carbopol 934.

5. Then add the required amount of triethanolamine.

6. Then homogenize the above mixture, add orange oil and form of hydrogel.

Formulation table:

Sr.no	Ingredient	F1	F2	F3	F4	F5	F6	F7	F8	F9
1	Extract of Aloe vera (ml)	35	35	35	35	35	35	35	35	35
2	Carbopol 934(mg)	100	100	100	200	200	200	300	300	300
3	Propylene glycol (ml)	7	5	3	7	5	3	7	5	3
4	Glycerine (ml)	1	1	1	1	1	1	1	1	1
5	Methylparaben (ml)	300	300	300	300	300	300	300	300	300
6	Triethanolamine(ml)	1	1	1	1	1	1	1	1	1
7	Distilled water(ml)	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S
8	Orange oil(ml)	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S

Table 3

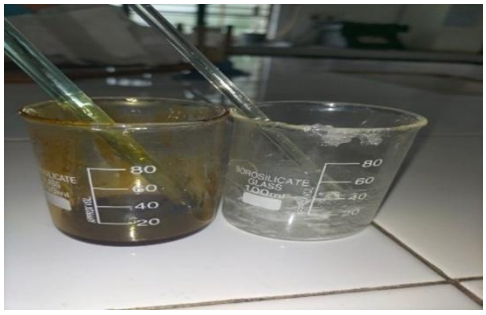

Fig 4: Formulation

Evaluation of Formulations:

1. **Physical evaluation:** Visual inspection was performed on physical characteristics such colour, look, and consistency.

2. **pH**: A digital pH metre was used to measure the pH of each formulation after around 1 g of gel was combined with 100 ml of water.

3.**Spreadability**: Spread-ability Standard-sized glass slides were taken in two sets. A 60mm-long piece of herbal formulation gel was sandwiched between the two slides. removed the extra gel that had attached to the glass slide surface and securely mounted it on a stand. A 20 g weight was fastened to the top slide, and

the weight had an impact on how long it took for the slide to travel 60 mm. The experiment was repeated three times to determine the meantime, and the following formula was used to determine the Spreadability.

Spreadability = (Weight × Length) / Time.

4.Percentage Moisture Content:

1.According to Devi8 et al.'s approach, the formulations' percentage moisture loss was calculated. Accurate two-gram formulations (Fl to F9) were weighed and stored in a desiccator with 50 grammes of anhydrous calcium chloride. The formulas were weighed after three days. The following calculation was used to determine the % moisture loss:

Percentage moisture loss = Initial weight - Final weight / Final weight X 100

5. Viscosity

The viscosity of the formulation was measured at 25 degrees Celsius using a Brookfield viscometer. The measurement was taken at 25 rpm speed by the L63 spindle.

6. Washability: The product was applied on hand and was observed under running water.

7.Anti-Bacterial Activity.

Test organism: Streptococcus aureus.

Sample: Formulated antibacterial herbal topical gel (Fl to F9).

Standard: Ciprofloxacin.

Culture Media: PDA, or potato dextrose agar, is used to test antibacterial properties.

Media preparation involved precisely weighing nutrient agar media and suspending it in 100 millilitres of distilled water within a conical flask. The medium was fully dissolved by heating it on a hot plate. Sterilisation of Media: Using a non-absorbent cotton bung, the conical flask holding the nutritional agar media was sealed

Aluminium foil was appropriately placed over the cotton bung and the conical flask's mouth.

After that, the medium was autoclaved for 20 minutes at 15 pounds to sterilise it.

Plate preparation: Let an agar plate to room temperature. In the event that the liquid is apparent on the agar's surface, invert the plate, partially cover it, and Permit the surplus liquid to exit the agar and evaporate. Label

each agar plate for each organism to be examined appropriately. The plates' incubation process: A 35°C + 2°C

temperature range is necessary. Measure zone size: After incubation, by using the scale the diameter is measured.

RESULT AND DISCUSSION:

1. Physical evaluation

Sr.no	Physical evaluation	Inference
1	Colour	Light white
2	Appearance	Good
3	Consistency	Semi solid

Table 4

The created hydrogel formulation is semisolid in consistency and has a light white colour which appearance is good by physical inspection.

1. pH

SR.NO	FORMULATION	pH
1	F1	4.58
2	F2	4.77
3	F3	5.12
4	F4	5.18
5	F5	5.32
6	F6	5.50
7	F7	5.96
8	F8	6.12
9	F9	6.14

Table 5

The prepared hydrogel formulation has Ph of F6 is =5.50

Fig 5: Digital pH meter

2. Spreadability:

Sr.no	Formulation	Spreadability
1	F1	1.76
2	F2	1.79
3	F3	1.82
4	F4	1.86
5	F5	1.92
6	F6	1.97
7	F7	1.70
8	F8	1.72
9	F9	1.78

Table 6

The prepared hydrogel formulation has good Spreadability at F6=1.97

Spreadability =(Weight x Length) / time

=(1x30mm)/15.16se

=1.97

Fig 6: Spreadability

3. Percentage moisture content

Sr.no	Formulation	% Moisture content
1	F1	93.23
2	F2	93.74
3	F3	93.98
4	F4	94.52
5	F5	94.86
6	F6	95.90
7	F7	92.10
8	F8	92.34
9	F9	92.96

Table 7

The prepared hydrogel formulation of % moisture content at F6=95.90%

4. Viscosity:

Sr.no	Formulation	Viscosity(cp)
1	F1	38.39
2	F2	3884
3	F3	3990
4	F4	4150
5	F5	4185

6	F6	4469
7	F7	4552
8	F8	4648
9	F9	4723

Table 8

The prepared hydrogel formulation viscosity is F6 =4469cp

5. Washability:

Sr.no	Formulation	Washability
1	F1	Easy washable
2	F2	Easy washable
3	F3	Easy washable
4	F4	Easy washable
5	F5	Easy washable
6	F6	Easy washable
7	F7	Easy washable
8	F8	Easy washable
9	F9	Easy washable

Table 9

All nine hydrogel formulation are easily washable.

6. Anti bacterial activity

The prepared hydrogel has good anti microbial activity

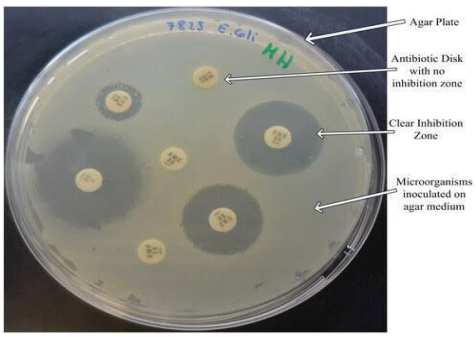

Fig 7: Antimicrobial activity

Conclusion:

Products made with herbs are thought to be safe for expanded periods of time. Compared to creams and treatments, topical organization of hydrogels at the pathological sites offers critical benefits in a faster release of a medication straight to the location of activity. Drugs have as of late been connected topically utilizing hydrogels, which are a common conveyance strategy. The drug's bioavailability may be expanded by the hydrogel formulation's prevalent retention properties. In Nine definition F6 group is perfect than other batches since their physical assessment, pH, Spreadability,% moisture substance, viscosity, washability, antibacterial movement these values are very comparative to the standard esteem. The plant's solid anti-inflammatory and anti-microbial properties have been archived in the writing. Herbal equations are getting to be more and more well known on the global showcase these days.

REFERENCE:

1. Rajendran A, Narayanan V, Gnanavel I Photochemical and Electrochemical Stabilities of Aloe Vera Sap Journal of Applied Sciences Research, 2007;3:1871-1878.
2. Eshu K, He Q "Aloe vera: a valuable ingredient for the food, pharmaceutical and cosmetic industries--a review". Critical reviews in food science and nutrition 2004;44:91-96.
3. Vogler BK, Ernst E "Aloe vera: a systematic review of its clinical effectiveness.
4. Amar S, Resham V, Saple DG Aloe vera: A short review. Indian J Dermato 2008;53: 163-166. ". The British journal of general practice: the journal of the Royal College of General Practitioners.
5. Plant Remedies Aloe Vera www.internethealthlibrary.com, downloaded on August 4,2010.
6. Kaur J, Kaur J, Jaiswal S, Gupta G. Recent advances in topical drug delivery system. Pharm Res. 2016;6(7):6353-9:
7. 14. Chitt Odiya P, Tomar RS, Ramchandani U, Manocha N, Agrawal S. Topical gel-A review. International journal of pharmaceutical & biological archives. 2013;4(4):606-13.
8. Patel Rahul R, Patel KR, Patel MR. Formulation and Characterization of Microemulsion based Gel of Antifungal Drug.5.
9. Yadav SK, Mishra MK, Tiwari A, Shukla A. Emu gel: a new approach for enhanced topical drug delivery. Int J Curr Pharm Res. 2016;9(1): 15-9.
10. Narasimhulu A, Tzammulferdous S. M. Niranjan Babu. A Review on Transdermal Drug Delivery System. Asian J Res in Biological and P'ceutical Scie. 2015;2:59-65.
11. 17. Asija R, Asija S, Sharma D, Dhakar PC, Nama N. Topical ointment: an updated review. Drug Discovery T'peutics. 2015;3(25):47-51.

12. Rathod HI, Mehta DP. A review on pharmaceutical gel. International Journal of Pharmaceutical Sciences. 2015 Oct 1;1(1):33-47.
13. AHMED A, SINGH L, SHARMA S. A Systematic Review On Curcumin As Topical Remedy. International Journal of Pharmaceutical Research. 2021 Apr; 13(2).
14. Peppas NA, Bures P, Leobandung, Ichikawa H. Hydrogels in pharmaceutical formulations. European Journal of Pharmaceutics and Biopharmaceutics, 2000; 50:27-46.
15. Devi A, Nautiyal U, Kaur SK. Hydrogels: a smart drug delivery device. Asian Pacific Journal of Health Sciences, 2014; 1:93-94.
16. 28. Singh SK, Dhyani A, Juyal D. Hydrogel: Preparation, Characterization and Applications. The Pharma Innovation Journal, 2017; 6:25-32.
17. L.K.J. Knapczyk, J. Krzck, M. Brzeski, E. Nirnberg, D. Schenk, H. Struszcyk
18. Das k.Dang R. and Machale M.U. formulation and evaluation of novel herbal gel,2009,p.117-122.
19. Abebe DG, Fujiwara T (2012) Controlled thermoresponsive hydrogels by stereocomplexed PLA-PEG-PLA prepared via hybrid micelles of pre-mixed copolymers with different PEG lengths. Biomacromolecules 13: 1828-1836.
20. Peppas NA, Bures P, Leobandung, Ichikawa H. Hydrogels in pharmaceutical formulations. European Journal of Pharmaceutics and Biopharmaceutics, 2000; 50:27-46.
21. 21. Ahmed EM. Hydrogel: Preparation, characterization, and applications. A review. Journal of Advanced Research, 2015; 6:105-121