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PREPARATION AND EVALUATION OF HERBO COOL HYDROGEL SHEET: A NATURAL DEFENCE AGAINST HERPES VIRUS

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ABSTRACT

Herpes simplex virus (HSV) infections are a significant public health issue, with traditional treatments often leading to drug resistance and adverse side effects. This has driven research into natural and herbal alternatives, such as the Herbo-cool hydrogel sheet. This hydrogel sheet was created using a blend of herbs, including oatmeal extract, garlic extract, and cucumber extract, all known for their antiviral, anti-inflammatory, and wound-healing properties. To enhance its mechanical strength and elasticity, the hydrogel underwent a freeze-thaw cycle. Its physicochemical properties were analyzed using scanning electron microscopy (SEM). In vitro antiviral assays demonstrated a significant reduction in HSV replication following application, indicating the hydrogel's potent antiviral properties. Cytotoxicity tests on human skin cell lines confirmed its safety. The hydrogel sheet's wound-healing capabilities were evaluated in an animal model, showing faster re-epithelialization and reduced inflammation. Stability and shelf-life studies indicated that the hydrogel retained its integrity and efficacy over an extended period under various storage conditions. In conclusion, the Herbo-cool hydrogel sheet represents a promising natural intervention against HSV, effectively combining traditional herbal medicine with modern hydrogel technology.

KEYWORDS: Garlic, Oatmeal, Cucumber, Hydrogel, Herpes Simplex Virus, Anti-Viral, Anti-inflammatory, Wound healing.

INTRODUCTION

Topical drug administration involves delivering drugs locally to specific areas of the body through routes such as ophthalmic, rectal, vaginal, and primarily, the skin. Among these, the skin serves as the most accessible organ for topical drug delivery. This method is employed to either treat skin conditions directly or to facilitate systemic drug effects. Hydrogels, which are three-dimensional networks of hydrophilic polymers held together by cohesive forces, are particularly valuable in controlled release applications. Due to their unique physical and chemical properties, hydrogels are widely utilized in topical drug delivery systems, allowing for controlled and extended drug release.

Herpes is a prevalent viral infection triggered by the herpes simplex virus (HSV), which comes in two primary forms: HSV-1, responsible for oral herpes (commonly known as cold sores), and HSV-2, which typically results in genital herpes. Transmission usually occurs through close personal contact. Although there is no definitive cure for herpes, antiviral medications can effectively alleviate symptoms and decrease the frequency of outbreaks. Herpes can manifest with symptoms such as painful blisters, itching, and flu-like symptoms during episodes, but it can also be asymptomatic.

There are multiple treatment options available for herpes viruses, primarily focusing on symptom management, outbreak reduction, and transmission prevention. These include antiviral medications, topical treatments, pain relievers, and warm baths. Herbal remedies are often utilized for antiherpes treatment due to their compounds' antiviral properties, which can impede the herpes virus's replication. Moreover, herbs are viewed as a natural and holistic approach to herpes management, offering an alternative to pharmaceutical drugs.

Hydrogels are composed of hydrophilic polymer chains that attract water molecules, finding wide applications such as wound dressings, contact lenses, drug delivery systems, and tissue engineering. Their ability to retain large amounts of water while maintaining structural integrity makes them versatile and biocompatible materials. Furthermore, hydrogels can be tailored to exhibit specific characteristics like elasticity, porosity, and responsiveness to environmental cues.

Numerous herbs have undergone investigation for their potential antiviral properties against the herpes virus. However, it's important to acknowledge that although certain herbs

demonstrate potential in laboratory studies, their efficacy in treating herpes in humans remains inconclusive.

Garlic has garnered attention for its potential medicinal benefits, particularly its antiviral effects against the herpes simplex virus (HSV). Allicin, a compound present in garlic, is believed to be responsible for its antiviral properties. Studies indicate that allicin exhibits activity against various viruses, including HSV, potentially by disrupting viral replication and thus reducing outbreak severity and duration. Apart from allicin, garlic contains other compounds like flavonoids and sulphur-containing compounds that may contribute to its antiviral activity. These compounds could potentially enhance the immune system, crucial for combating viral infections like herpes. Although garlic shows promise as a natural remedy for herpes, further research is necessary to fully comprehend its efficacy and determine the optimal method of utilization for this purpose.

Oatmeal, often praised for its nutritional value as a breakfast staple, also boasts therapeutic qualities when applied topically to address skin conditions like herpes outbreaks. Rich in compounds like avenanthramides, oatmeal exhibits anti- inflammatory and antioxidant properties, offering relief from pain and discomfort associated with herpes flare-ups. Its topical application soothes irritated skin, diminishes inflammation, and eases itching, burning, and pain caused by herpes lesions. Moreover, oatmeal forms a protective barrier on the skin, potentially preventing further irritation and infection. Its moisturizing abilities also aid in skin hydration, facilitating quicker healing. One common approach to utilizing oatmeal for herpes pain relief involves preparing an oatmeal bath. This entails adding colloidal oatmeal (finely ground oatmeal) to warm bathwater and soaking in it for approximately 15-20 minutes. Alternatively, a paste can be created by blending colloidal oatmeal with water and applying it directly to the affected area for localized relief. It's crucial to understand that while oatmeal can alleviate symptoms, it does not provide a cure for herpes.

Cucumber, scientifically referred to as Cucumis sativus, is a widely acknowledged vegetable recognized for its hydrating properties and skin-cooling effects. Although scientific evidence specifically addressing cucumber's efficacy in treating herpes is limited, anecdotal accounts suggest that its soothing and cooling characteristics may alleviate discomfort associated with herpes outbreaks. Cucumber's cooling sensation is attributed to its high-water content, which hydrates the skin and relieves irritation. Additionally, cucumber contains various compounds

such as flavonoids, lignans, and tannins, which possess anti-inflammatory properties that may help reduce redness and swelling linked to herpes lesions.

Fig. no. 01- Hydrogel.

Plant profile

1. Allium sativum (Garlic)

Allium sativum, a species of onion in the genus Allium, is the scientific name for garlic. It originated in Central Asia, where it has been grown for thousands of years for both culinary and therapeutic uses. Due to its many supposed health benefits, including as strengthening the immune system, lowering blood pressure, and treating a variety of ailments, garlic has a long history in traditional medicine. Furthermore, studies on the possible therapeutic benefits of garlic have been conducted by scientists.

Fig. no. 02: Garlic.

Taxonomy

- Kingdom- Plantae.
- Phylum– Magniliophyta.
- Class- Liliopsida.
- Order– Asparagales.

- Family- Alliaceae.
- Genus- Allium.
- Species- Allium sativum.
- Common name- Garlic.

Botanical description

In the Allium genus, garlic (Allium sativum) is a perennial bulbous plant that is closely related to onions, leeks, and chives. It usually reaches a height of two feet and yields clusters of underground bulbs, each with several cloves encased in a papery skin. The plant's base produces long, narrow, flat leaves that can grow up to 12 inches in length. Little white flowers in the shape of stars cling to the flower stalk, called a scape, which grows out of the plant's centre. But the main reason garlic is grown is for its flavourful and aromatic bulbs, which are used in a variety of culinary and medicinal applications**.**

Chemical constituents

Many chemical components found in garlic affect its flavour, aroma, and possible health benefits. Among these is allicin, a sulfur-containing compound that is produced when garlic is chopped or crushed. It has antimicrobial qualities and may help support immune system and cardiovascular health. Furthermore, when garlic is processed or aged, diallyl sulphides, such as diallyl disulfide and diallyl trisulfide, form. These compounds not only give garlic its unique flavour and aroma but also have antibacterial and antioxidant qualities. Garlic's antioxidant capacity and potential health benefits are further enhanced by the presence of sulfur-containing amino acids like alliin, flavonoids like quercetin and kaempferol, and vital vitamins and minerals like vitamin C, vitamin B6, manganese, and selenium.

Uses

- One of the most well-known uses of garlic is its broad-spectrum antimicrobial activity, which includes fighting off parasites, fungi, viruses, and bacteria.
- According to research, allicin, a major ingredient in freshly crushed garlic, has antiviral properties and works well against a variety of bacteria.
- Although studies have investigated the potential antiviral effects of garlic, especially through compounds like allicin, against herpes viruses, more research is required to determine how effective garlic is at treating human herpes infections.

- Garlic has many health advantages in addition to its antibacterial qualities. It might help lower cholesterol and blood pressure, strengthen the heart, boost the immune system, and possibly even prevent some types of cancer.
- Garlic's detoxifying and anti-inflammatory qualities can also help with ailments like arthritis and enhance general health.
- Additionally, it appears promising in easing respiratory and digestive issues, improving skin health, and promoting hair growth.

2. Oatmeal (Avena sativa)

Oats, (Avena sativa), domesticated cereal grass (family Poaceae) grown primarily for its edible starchy grains. Oats are widely cultivated in the temperate regions of the world and are second only to rye in their ability to survive in poor soils. Although oats are used chiefly as livestock feed, some are processed for human consumption, especially as breakfast foods. The plants provide good hay and, under proper conditions, furnish excellent grazing and make good silage (stalk feed preserved by fermentation).

Fig. no. 03: Oatmeal.

Biological activity of oatmeal

Oatmeal is commonly employed as a soothing remedy for various skin conditions, including herpes outbreaks. Although oatmeal doesn't directly combat the herpes virus, it effectively alleviates the discomfort and pain associated with lesions. Its anti- inflammatory properties alleviate itching and irritation, while its moisturizing qualities soothe dry, irritated skin. Moreover, oatmeal forms a protective barrier over the affected area, facilitating healing and preventing further irritation. Utilizing oatmeal as a topical treatment for herpes lesions provides symptomatic relief and aids in the healing process. For an oatmeal bath, place approximately one cup of oatmeal into a nylon sock and position it over the tap. Allow warm water to flow through the oatmeal, then soak in the bath for as long as desired.

Chemical constituents

Oatmeal primarily consists of carbohydrates, fiber, and protein. It also contains vitamins such as thiamine (B1), riboflavin (B2), niacin (B3), and folate (B9), as well as minerals like calcium, iron, magnesium, phosphorus, potassium, and zinc. Oatmeal is also a good source of antioxidants and phytochemicals. Oatmeal contains compounds such as avenanthramides, which have anti-inflammatory properties that may help relieve pain associated with conditions like herpes. Additionally, the soothing texture of oatmeal can provide a comforting sensation when applied topically to affected areas. However, it's important to note that while oatmeal may offer some relief, it is not a cure for herpes, and medical treatment should be sought for managing the condition.

3. Cucumber (Cucumus sativus)

Cucumber, scientifically known as Cucumis sativus, is a widely cultivated plant belonging to the gourd family, Cucurbitaceae. Cucumber belongs to the plant kingdom (Plantae), order Cucurbitales, and family Cucurbitaceae. It is closely related to other cucurbits such as squash, pumpkin, and melons. Cucumbers are native to South Asia but are now cultivated in many parts of the world with temperate or subtropical climates. They are commonly grown in gardens, greenhouses, and farms. Cucumber plants are annual vines with creeping or climbing stems that can grow up to several meters in length. The leaves are large, lobed, and palmate, with rough, prickly surfaces. The plant produces both male and female flowers, with the female flowers developing into the fruit.

Fig. no. 04: Cucumber.

Cultivation

Cucumbers are typically grown as annual crops, starting from seeds planted directly in the soil or transplanted seedlings. They require well-drained soil, ample sunlight, and consistent

watering. Trellising or providing support structures helps optimize space and airflow for healthy growth.

Chemical constituents

Cucumbers are primarily composed of water (about 95%) along with essential nutrients such as vitamin K, vitamin C, potassium, and various phytonutrients including flavonoids and lignans. Additionally, cucumbers contain small amounts of other vitamins and minerals like vitamin A, vitamin B6, folate, calcium, and magnesium.

Uses

Cucumber is frequently praised for its cooling and soothing attributes, rendering it sought-after in skincare and topical remedies. In a herpes virus hydrogel sheath scenario, the inclusion of cucumber could potentially deliver a soothing sensation to alleviate any discomfort or irritation linked with the herpes virus outbreak. However, it's important to note that while cucumber may offer relief from symptoms.

MATERIALS AND METHODOLOGY

Materials used: Garlic extract, Oatmeal extract, Cucumber extract, Guar gum, Glycerin, Borax, Distilled Water.

Equipment used: Weighing balance, pH meter, UV Spectrophotometer, IR Spectroscopy.

Glassware used: Conical flask, Glass rod, Spatula, Beaker, Butter paper, Funnel, Water bath, Pipette, Rubber bulb, Filter paper, Petri dish.

Preparation of garlic extract

- Fresh Garlic was procured from the market.
- The peels of garlic were delicately separated and garlic cut into the small pieces, as shown in fig. no. 09.
- Then small pieces were allowed to stand in ethanol solution for 7 days, as shown in fig. no. 10.
- After 7 days, the extract was filtered into the iodine flask and the presence of required components was tested, as shown in fig. no. 11.

Fig. no. 05: Chopped Garlic.

Fig. no. 06

Fig. no. 07- Garlic extract.

Preparation of oatmeal extract

- Oatmeal was procured from the market.
- Then the oatmeal was put into the ethanol solution and allow to stand for 7 days, as shown in fig. no. 13.
- After 7 days, the extract was filtered into the iodine flask and the presence of required components were tested, as shown in fig. no. 14.

Fig. no. 08

Fig. no. 09

Fig. no. 10

Preparation of cucumber extract

- Fresh Cucumber were procured from the market, then conscientiously washed.
- The cucumber cut into the small pieces, as shown in fig. no. 15.
- Then small pieces were allowed to stand in ethanol solution for 7 days, as shown in fig. no. 16.
- After 7 days, the extract was filtered into the iodine flask and the presence of required components was tested, as shown in fig. no. 17.

Fig. no. 11

Fig. no. 12

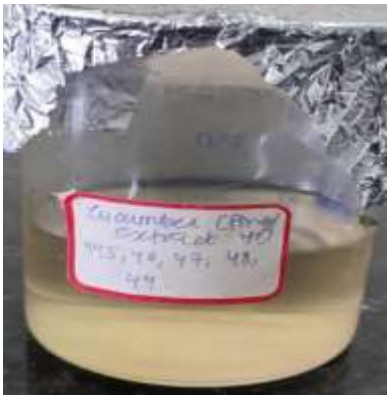


Fig. no. 13

Formulation of the hydrogel sheet

Procedure

- **Step 1:** The hydrogel base was created by dissolving guar gum in water until it reached a thick consistency.
- **Step 2:** Once the desired consistency was achieved, the extracts were incorporated into the base solution in the necessary amounts.
- **Step 3:** The entire solution was stirred thoroughly for 10 minutes.
- **Step 4:** Then poured into petri plates and left to cool while the reaction occurred.
- **Step 5:** After sometimes we will get hydrogel sheet.

Fig. no. 14: Hydrogel.

Formula

Table no. 01: Formula of F1 and F2.

Ingredients	Role	F1	F2
Garlic extract	Anti- Viral agent	7.2 ml	0.75 ml
Oatmeal extract	Analgesic	1.25 ml	1.25 ml
Cucumber extract	Cooling effect	10 ml	10 ml
Guar gum	Gelling agent	0.45 gm	0.45 gm
Glycerin	Co-solvent	5 gm	5 gm
Borax	Preservative	0.4 gm	0.4 gm
Distilled water	Aqueous base	45 ml	45 ml

Physiochemical properties of all extract

1. Garlic

Preliminary test for presence of allicin in garlic extract.

Table no. 02: Chemical test of Garlic.

Test	Observation	Inference
Sulphur test /lead acetate test: 2ml of extract +3-4 drops of lead acetate and 2-3 drops dil. NaOH mixed till the precipitate dissolved and then boil for 2 min and cooled.	Appearance of brownish black precipitate.	Presence of allicin in garlic extract or present sample.

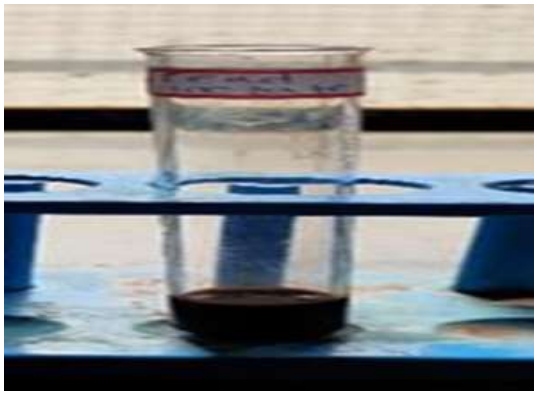


Fig. no. 15: Lead acetate test.

2. Cucumber

Preliminary test for presence of carbohydrate and protein in cucumber extract.

Table no. 03: Chemical test of Cucumber.

Test	Observation	Inference
Benedicts test: 2ml of extract +2ml of benedict's reagent.	Orange-red precipitate appearance.	The presence of carbohydrate.
Biuret test: 2ml of cucumber extract +aqueous copper sulphate.	Greenish colouration.	Presence of protein

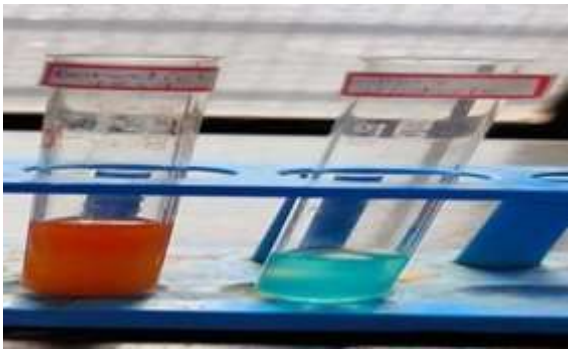


Fig. no. 16: Chemical test of cucumber.

3. Oatmeal

Preliminary test for presence of tannins and alkaloid in oatmeal extract.

Table no. 04: Chemical test of Oatmeal.

Test	Observation	Inference
Ferric chloride test: 2ml of oatmeal extract + 3-4 drop of $fecl_3$	Blue colour formation.	Presence of tannins.
Wagner's test: 2ml of extract + Wagner's reagent	Reddish brown precipitate	Presence of alkaloids.
Meyer's test: 2ml of extract + 1ml of Meyer's reagent.	Pale yellow precipitate	Presence of alkaloids

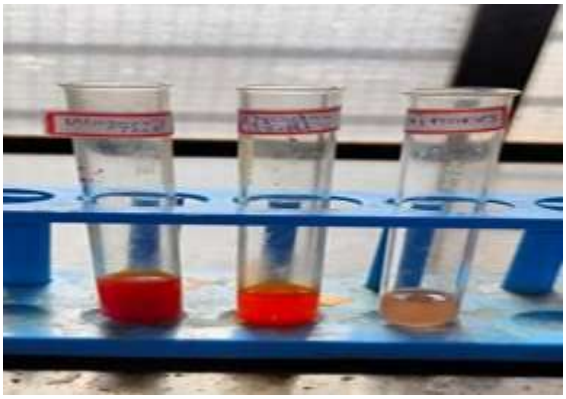


Fig. no. 17: Chemical test of Oatmeal.

Evaluation parameters

1. Physical evaluation

The prepared hydrogel formulation was inspected visually for their color, homogeneity, consistency, grittiness, texture, and phase separation.

Table no. 05: Physical parameters of formulation.

Formulation	Color	Homogeneity	Consistency	Phase separation
F1	White	Excellent	Excellent	None
F2	White	Excellent	Excellent	None

Fig. no. 18- F1 Formulation.

Fig. no. 19- F2 Formulation.

2. pH Detection

The pH of the preparation is determined using a pH meter.

- Calibrate the pH meter according to the manufacturer's instructions.
- Prepare the formulation sample (F1) in a suitable container.
- Immerse the pH meter electrode into the formulation sample.
- Allow sufficient time for the pH reading to stabilize.
- Record the pH value displayed on the pH meter.
- Rinse the pH meter electrode with distilled water, then repeat the process for F2 formulation.

Table no. 06: pH of F1 and F2.

Sr. no.	pH
F1	7.08
F2	7.09

Fig. no. 20- pH of F1.

Fig. no. 21- pH of F1.

3. Viscosity detection

The viscosity of the preparation is determined using a Brookfield Viscometer.

- Calibrate the viscometer according to the manufacturer's instructions.
- Prepare the formulation sample in a suitable container.

- Set up the Brookfield viscometer with the spindle no. 6 at 10 rpm and 25°C.
- Carefully load the prepared sample into the viscometer's sample chamber, ensuring there are no air bubbles trapped in the sample.
- Lower the spindle into the sample and start the viscometer.
- Allow the spindle to rotate at a constant speed while immersed in the sample, recording the viscosity reading once the measurement stabilizes.

Fig. no. 22: Viscometer.

Table no. 07: Viscosity of F1 and F2.

Formulation	Viscosity value
F1	1900cp
F2	1850cp

4. Drug content

An accurately weighed 100 mg sample of topical hydrogel was mixed with 20 ml of pH 7.4 phosphate buffer in a beaker. After thorough mixing, the solution was filtered through Whatman filter paper no.1. Then, 1 ml of the filtered solution was diluted to 10 ml with pH 7.4 phosphate buffer in a volumetric flask. The final solution was analyzed using UV spectrophotometry at a λ max of 275 nm.

Table no. 08: Garlic drug release.

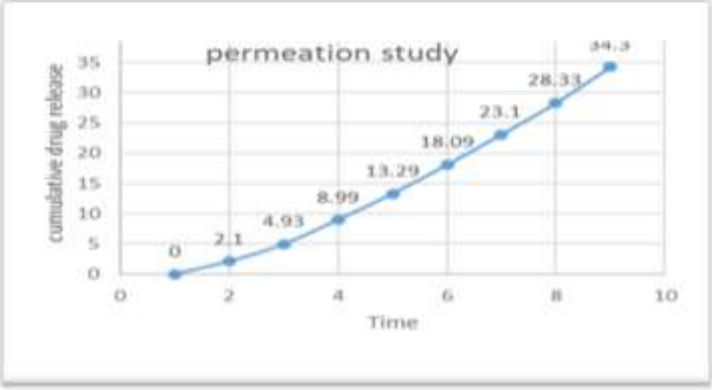
Time	Abs	Conc (%)	CDR
15	0.063	2.1	2.1
30	0.085	2.83	4.93
45	0.122	4.06	8.99
60	0.159	4.3	13.29
75	0.716	4.8	18.09
90	0.21	5.01	23.1
105	0.249	5.23	28.33
120	0.283	5.97	34.3

Table No. 09: Cucumber drug release.

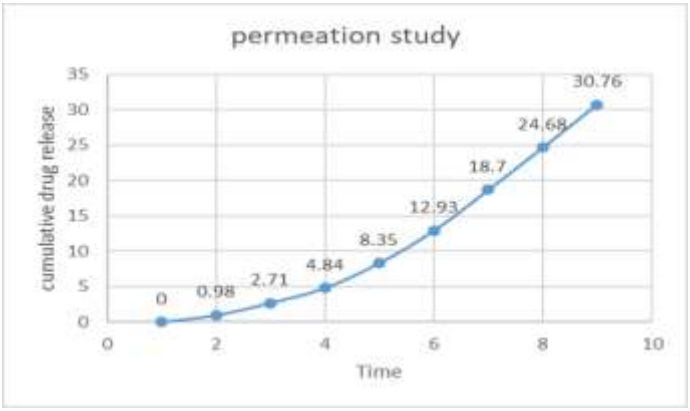
Time	Abs	Conc (%)	CDR
15	0.025	0.98	0.98
30	0.044	1.73	2.71
45	0.054	2.13	4.84
60	0.089	3.51	8.35
75	0.116	4.58	12.93
90	0.146	5.77	18.7
105	0.167	5.98	24.68
120	0.197	6.08	30.76

Table No 10: Oatmeal drug release.

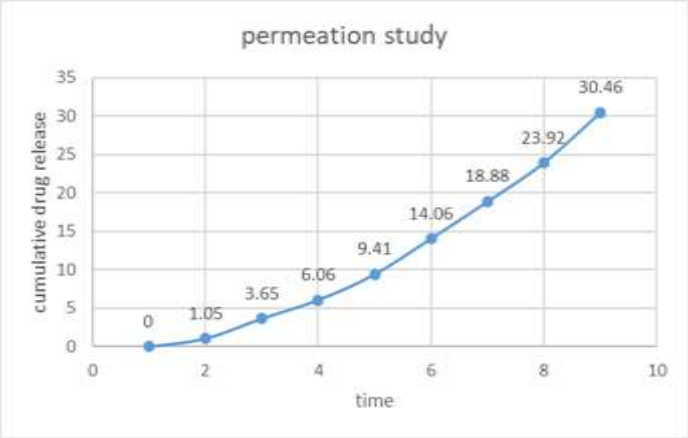
Time	Abs	Conc (%)	CDR
15	0.021	1.05	1.05
30	0.052	2.6	3.65
45	0.067	2.41	6.06
60	0.093	3.35	9.41
75	0.134	4.65	14.06
90	0.168	4.82	18.88
105	0.182	5.04	23.92
120	0.221	6.54	30.46



Graph no. 01: CDR Curve of Garlic Extract.



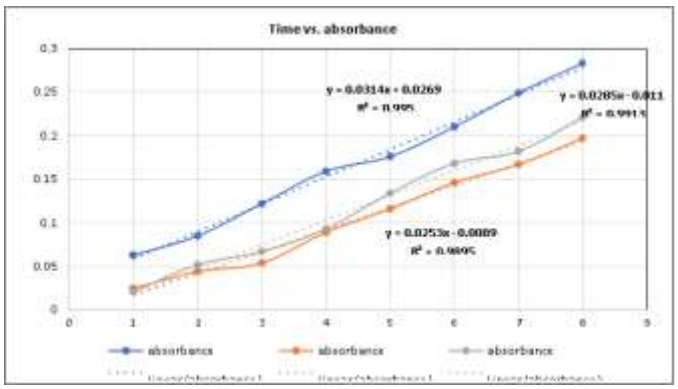
Graph no. 02: CDR Curve of Cucumber Extract.



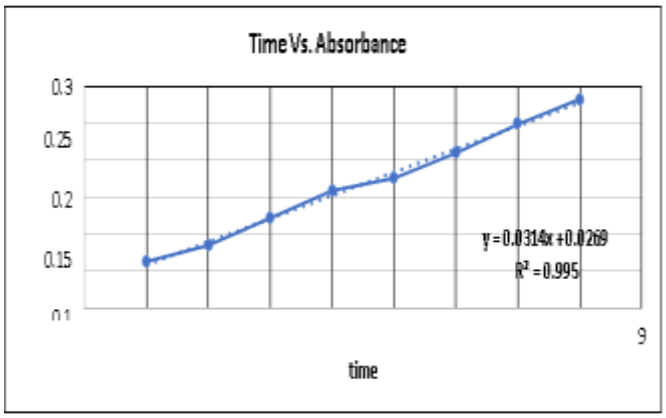
Graph no. 03: CDR Curve of Oatmeal Extract.

5. In-Vitro drug release study

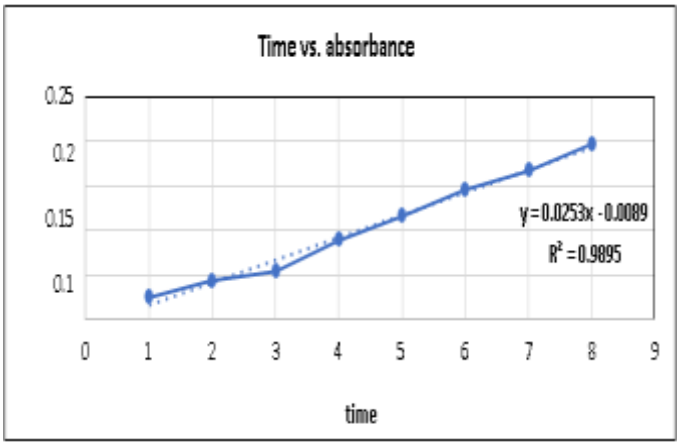
- The hydrogel formulation was subjected to an in vitro drug release assessment using a Franz diffusion cell equipped with a cellophane membrane.
- The membrane was securely mounted onto the cell.
- The formulation was introduced into the donor compartment of the diffusion cell, while the reservoir compartment was filled with 25 ml of phosphate buffer at pH 7.4.
- The study was conducted under controlled conditions at 37±1°C and a stirring speed of 100 rpm for a duration of 2 hours.
- Samples were withdrawn from the reservoir compartment at 15-minute intervals and their absorbance was measured spectrophotometrically at wavelengths of 217nm, 237nm, and 241nm.
- After each sampling, the reservoir compartment was replenished with an equivalent volume of phosphate buffer at pH 7.4.
- This experimental setup allowed for the systematic investigation of drug release behaviour from the hydrogel formulation over time.



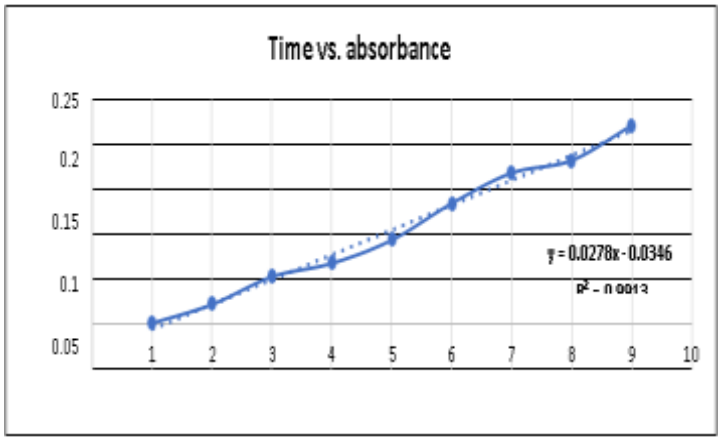
Graph no. 04: Diffusion Curve of all Extract.



Graph no. 05: Diffusion curve of garlic extract.



Graph no. 06: Diffusion curve of cucumber extract.

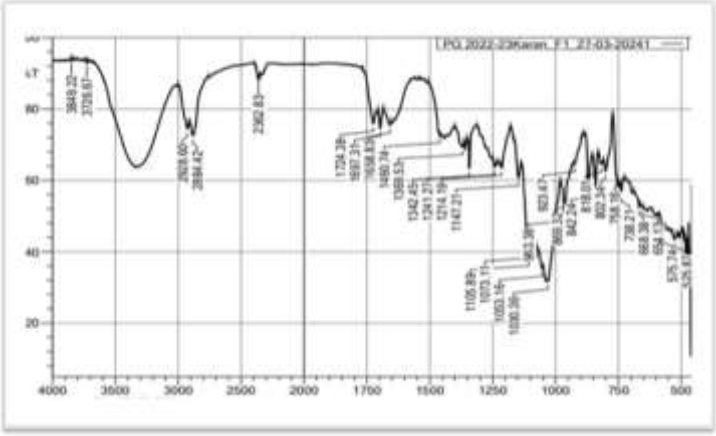


Graph no. 07: Diffusion curve of oatmeal extract

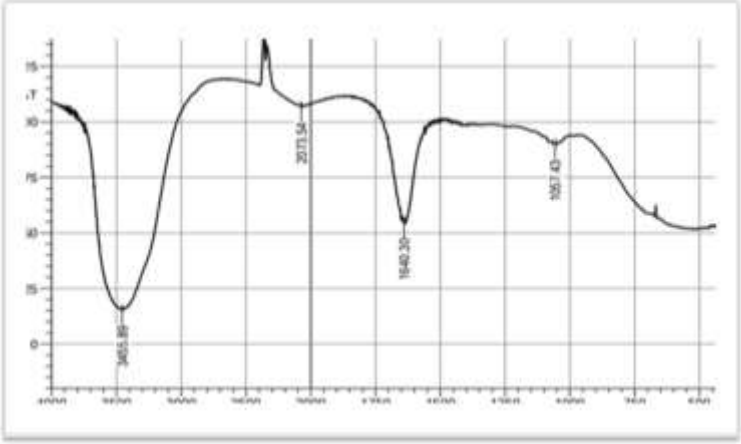
6. FTIR Spectroscopy

- FTIR drug characterization study conducted as per standard procedure.
- Graph displays spectra of given formulation.
- Principal peak of drug observed.

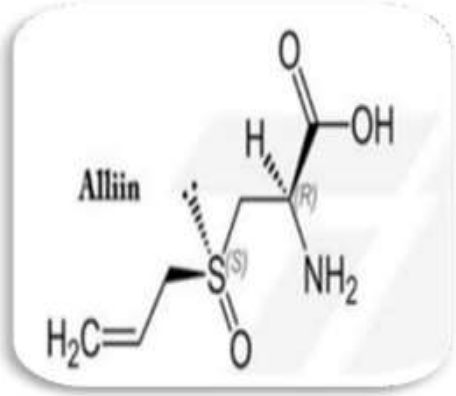
- F1 Formulation IR spectrum reveals bands at 2884.42 cm-1, 2362.83 cm -1, 1030.36 cm -1 indicating aldehyde, alcohol, ether, and carboxylic acids.
- Additionally, bands at 575.74 cm-1, 668.38 cm-1 signify bromide, iodide, and chloride groups.
- No physical or chemical changes observed in pure drug.



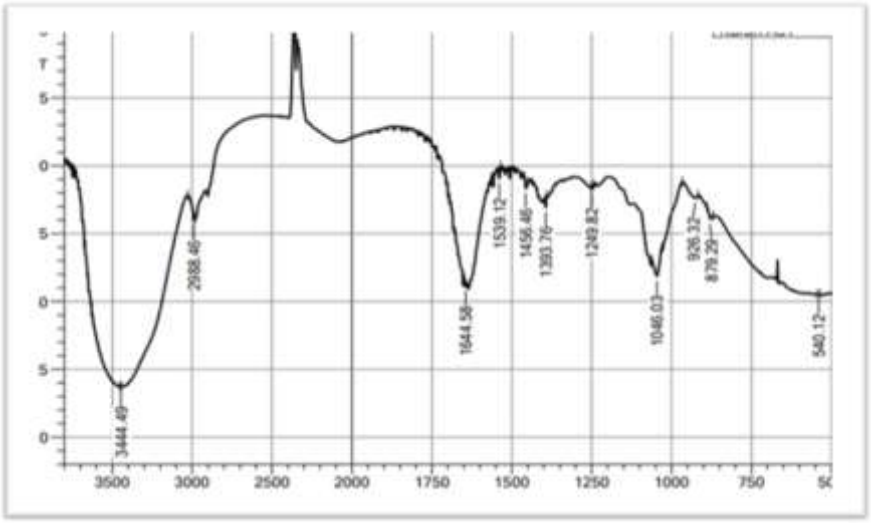
Graph no. 08: FTIR Spectra of F1 Formulation.



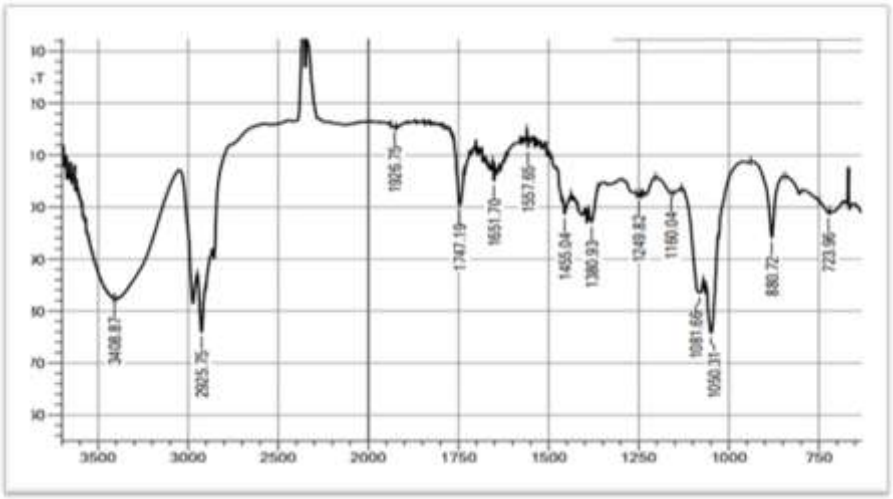
Graph no. 09: FTIR Spectra of Cucumber extract.



Allicin structure



Graph no. 10: FTIR spectra of Garlic formulation.



Graph no. 11: FTIR Spectra of Oatmeal extract.

RESULTS

The following tests were performed for the optimized F1 and F2 formulation and mentioned below the result:

Table no. 11: Results of all tests.

Tests	Result for F1	Result for F2
pH	7.08	7.09
Viscosity	1900 cp	1850 cp
Drug Content	0.19	0.26
Skin Irritation	No irritation	No irritation

The most important test i.e. Drug content of the extract is also carried out using a UV Spectrophotometer. Such that Dilution has been made by finding the spectra of their respective ingredient showing maximum absorbance.

- The Garlic shows the spectra at 217 nm.
- The Cucumber shows the spectra at 237 nm.
- The Oatmeal shows the spectra at 241 nm.

CONCLUSION

- The study identifies compounds within herbal remedies historically utilized for treating Herpes caused by Herpes Simplex Virus (HSV) that exhibit anti-herpes activity.
- These compounds demonstrate potential as effective anti-herpes agents in new medications aimed at preventing skin issues.
- Formulations exhibit indications of relief, favourable skin irritation tolerance, and high bioavailability, affirming their safety as a viable option.

DISCUSSION

- The ingredient with the active constituent successfully passes the chemical test during the evaluation studies conducted by chemical testing.
- Physicochemical characteristics such as colour (White), odour (odorless), and absence of skin irritation were examined in the formulation.
- The formulation maintains a pH range of 5 to 7.5, making it an ideal range for a hydrogel applied topically.
- The remarkable pain-relieving properties of Herbo-cool hydrogel contribute to its significant bioavailability and favourable therapeutic impact. Consequently, Herbo-Cool Hydrogel Sheet has been formulated.

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