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# FORMULATION AND EVALUATION OF POLYHERBAL GEL CONTAINING JACKFRUIT, BANANA PEEL AND ALOE VERA, NEEM, CURCUMIN, FOR THE TREATMENT OF PSORIASIS DISEASE

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**Introduction**:

Psoriasis is an enduring autoimmune disease which causes inflammation to the skin. Psoriasis is categorized by different clinical manifestations and each class of psoriasis is characterized by examine the mild, moderate to severe symptoms on skin. These symptoms generally include the white or red colour of irregular skin; the patches are commonly itchy and scaly to the skin.[1] Psoriasis skin is evaluated by itching, red scalps, white scales and rashes are developed on the skin. In psoriasis commonly the skin, joints and nails are affected. However, there are different clinical types of psoriasis are available, but the plaque type of psoriasis is the most common obtainable form of psoriasis which affect most of peoples worldwide. Psoriasis is a non-epidemic infectious disease and terrible skin disorder, which affects the person emotionally, psychologically and clinically.[2, 3] In the study of (IFPA) International Federation of Psoriasis Associations, just about the 3 % of the world's population has affected by psoriasis. The estimate is about 125 million peoples.[4] In India, there is about 10 million cases of psoriasis are observed annually. So according to their increasing growth it enlists under common skin disorder, and at present it is important to doing more work for the treatment of psoriasis.

Nowadays, many treatments are available which include topical, biological, systemic agents are used. Some of the agents are helpful to reduce the symptoms of psoriasis but they have some side effects also. In the meantime it is important to develop the treatment with good efficacy and fewer side effects. As compare to allopathic agents the herbal drugs are safer and effective to reduce the symptoms of psoriasis. Because of their minimum adverse effects they are trending in the research.[5]

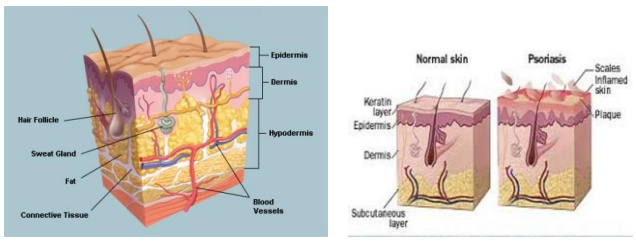


Fig 1. Normal skin & Psoriasis skin.

**PlantProfiles:**

***Artocarpus heterophyllus Lam (Jack fruit):*** *Artocarpus heterophyllus Lam* is a species of tree of the mulberry family Moraceae. It is also known as jackfruit (Eng.), Kathal (Hindi), Kanthal (Beng.). It is native to Western Ghats of India, Malaysia, central and eastern Africa and south-eastern asia[1]. Jackfruit *(Artocarpus heterophyllus* Lam) was flakes of ripe fruits are high in nutritive value; every 100 gm of ripe flakes contains 287-323 mg potassium, 30.0-73.2 mg calcium and 11-19 gm carbohydrates. The *Artocarpus heterophyllus* (Figure 1) contains various chemical constituents as several flavones colouring matters, morin, dihydromorin, cynomacurin, artocarpin isoartocarpin, cyloartocarpin, artocarpesin, oxydihydro artocarpesin, artocarpetin, norartocarpetin, cycloartinone and artocarpanone[6].

The heart wood on analysis yields moisture 6.7%, glucosides 38.0%, lipids 0.7%, albumin 1.7% and cellulose 59.0%. The plant also contains free sugar (sucrose), fatty acids, ellagic acid and some essential Amino acids like Arginine, cystine, histidine, leucine, lysine, metheonine, theonine, and tryptophan[3]. The leaves and stem show the presence of sapogenins, cycloartenone, cycloartenol, β-sitosterol and tannins, they show estrogenic activity. A root contains β-sitosterol, ursolic acid, betulinic acid and cycloartenone[7].


**Figure 2: Fruit of *Artocarpus heterophyllus Lam* (Jackfruit, Kathal)**

**Aloevera (Barbaloin):**

A phytoconstituents "Barbaloin" which is obtained from the plant *aloe vera* is used for the effective treatment of psoriasis[5]. According to the investigation Patel DK *et al.,* 2012 had revealed that Barbaloin shows good antiinflammatory, antimicrobial and antipsoriatic property.[8] Barbaloin make use of their protective action mainly through antioxidant and antiinflammatory mechanisms. Hence, Barbaloin up-regulated TFGβ1, bFGF, and Vegf-A expression in fibroblasts and increased keratinocyte proliferation and differentiation by lysosomal membrane stability. Additionally, Furthermore, Barbaloin exerted skin protection by reducing IL-8 production, DNA damage, lipid peroxidation, and ROS generation and by increasing GSH content and SOD activity.[9]

**Figure 3: Aloevera plant**

**NEEM EXTRACT**

**Synonyms:** Neem, Nimtreee, Indian lilac

**Biological Source:** Neem tree

**Family**:-Meliceae

**Neem consists of about**: Neem fruit, seeds, leaves, stems, and bark contain diverse phytochemicals, some of which were first discovered in azadirachta seed extracts, such as Azadirachta established in the 1960s as an insect antifeedant, growth disruptor, and insecticide. The yield of Azadirachtin from crushing 2 kg of seeds is about 5 g.In addition to Azadirachta andrelated limonoids, the seed oil contains Glycerides,diverse Polyphenols,nimbolide, triterpenes, and beta-sitosterol. The yellow, bitter oil has a garlic-like odor and contains about 2% of limonoids compounds.[10]The leaves contain quercetin, catechins, carotenes, and vitamin C.

**Uses:** Neem leaves are dried in India and placed in cupboards to prevent insects eating the clothes, and also in tins where rice is stored. The flowers are also used in many Indian festivals like Ugadi**,** as a vegetable**,** Traditional medicine, Insecticide, Pesticide, Neem oils for polymeric resins.

**Figure 4: Neem leaves powder**

**CURCUMIN**

**Synonyms:** Curcumin, Curcuma Longa, Turmeric Root, and Wild Curcuma.

**Biological source:** Curcumin is the active ingredient of the dietary spice turmeric and is extracted from **the rhizomes of C. longa**, a plant in the Zingiberaceae

**Family:** Zingiberaceae

**Uses:**

Turmeric has a long history of being used for infections and kidney stones. The use in psoriasis is a relatively new adjunct. The anti-inflammatory components are thought to be contained in the curcuminoids and volatile oil swhich function through selective inhibition of phosphorylase kinase (PhK). PhK is an enzyme found in the epidermis. Significantly higher levels have been noted to correlate with clinical activity of psoriasis[11]. It is also reported decreased PhK activity in the curcumin and calcipotriol treated groups corresponded to severity of parakeratosis, decreases in keratinocyte Trans ferrin receptor expression and density of epidermal CD8 + T cells. The study did not report any adverse effects, although contact dermatitis is areportedadverseeffect.

**Figure 5: Rhizomes of curcumin powder**

**BANANA PEEL:**

**Synonym:** plantain ,rainiest, banana tree

**Family:** Musaceae

**Genus:** Musa

**Biological source: A banana** is an elongated, edible fruit – botanically a berry – produced by several kinds of large herbaceous flowering plants in the genus *Musa*. In some countries, bananas used for cooking may be called "plantains", distinguishing them from **dessert bananas**. The fruit is variable in size, colour, and firmness, but is usually elongated and curved, with soft flesh rich in starch covered with a rind, which may be green, yellow, red, purple, or brown when ripe. Banana peel is loaded with minerals, antioxidants that can and helps keep it soft and supple. But most importantly, it contains natural anti-inflammatory, antiseptic and cooling properties that can effectively ease the psoriasis[12].

**Figure 6: Banana peel powder**

The aim of the present study is to formulate and evaluate poly herbal gel. The main function of herbal gels is to provide mechanical strength to the formulation and increase their swelling behavior.[8] their shape, stability and softness are similar with the soft neighboring tissues and they have good rheological properties and tissue compatibility. To achieve the objectives, formulation were prepared by suitable method and further the effect of each gelling agent in formulations was examined in terms of physical appearance, pH, homogeneity, grittiness, viscosity, and Spreadability and swelling index. The observed results were helps us to find the best optimized formulation of herbal gels. To find the diffusion mechanism of drug release the optimized formulations was interpreted by kinetics models[13].

## MATERIALS AND METHODS

### Materials and Equipments

Barbaloin was purchased from Yacht Parma, Hyderabad, India, Carbopol 934 and Carbopol 940 was purchased from Carbanio chemicals industries (Biocon, Bangalore), India, Xanthan gum and methyl paraben was purchased from Carbanio chemicals industries (Biocon, Bangalore), India, carbopol 71G NF, Glycerine, propylene glycol, Transcutol P, propyl paraben and triethanolamine were purchased from Central drug house Pvt. Ltd. New Delhi, India. Ethanol was purchased from HiMedia Laboratories Pvt. Ltd, Mumbai, India.

LAB INDIA 3000 model of UV-Visible Spectrophotometer was used, FTIR Spectrophotometer of Shimazadu Affinity-1 was used. Magnetic stirrer, Sonicator, hot air oven, digital melting point apparatus and digital pH meter of Rolex brand was used. The magnetic analytical balance of Wisner was used in experiment.

### Methods

### Preformulation Study of poly herbal gel

### Physical description

Herbal gel was observed macroscopically with the help of hand held lens against black and white background. The observations were recorded to understand the physical appearance of gels.

**Determination of Melting Point:** Melting point of herbal gel was examined by capillary method. A fine powder of herbal gel

was filled in the capillary tube (previously fused from one end) and then placed the capillary in digital melting point equipment. The temperature was visualized in digital display of meter, now with the increase of temperature the sample was converted into melting range, after that the melting range were noted down.[14]

**Partition Coefficient**

The partition coefficient is useful to find out the lipophilic and hydrophilic nature of drug. Shake flask method is used to determine the partition coefficient. In this method octanol was used as non-aquas phase and distilled water is used as aquas phase. Earlier than, the addition of drugs, both phases were pre-saturated with each other. Equal quantities of each phase is taken in 1:1 v/v ratio and shake the mixture of both phases overnight in a water bath shaker. After the complete mixing both the phases are separated from shake flask funnel and centrifuged to obtain a clear supernatant layer with dissolved drug. After the suitable dilution, samples were analyzed using UV-Visible Spectrophotometry. The partition coefficient of drug KO/W and log P were calculated using formula.[15]

**Thin Layer Chromatography**

The standard size TLC plates are used to improve the reproducibility. The plates are prepared with the help of silica gel, the thick layer of the mixture of silica gel is spreaded over the plates and the thickness of slurry is maintained about 1-1.5 mm. After preparation the plates were dried for 30 minutes in hot air oven at 1100C. The melting point capillary is used to make spot. The capillary were filled by dilute solution and the solvent will allow drug solution for evaporation and again spot on same position[16]. By this process a small or concentrated spot is applied. TLC chamber were used which contains ethyl acetate-methanol-water as solvent system (100:13.5:10) ratio. The prepared plates were placed in TLC chamber and then the chamber is closed with a lid. The plates will allow to making spots and after that remove the plates and dry with sunlight. After the successful drying the colored spots are detected by spraying 10% ethanolic KOH reagent and visualize under UV chamber at 365 nm.[17]

The Rf value of prepared plates was calculated by using the formula:

**FTIR Spectroscopy**

The functional groups of herbal drugs were determined by FTIR (Shimazadu IR Affinity-1) Spectrophotometry. In the process of FTIR analysis the mixture of drug is added in a dry and fine powder of potassium bromide. Both the compounds were mixed in mortar and pestle and then compressed into a KBr disc in a hydraulic pressure of 75 Kg/cm. Each disc is scanned in the resolution of 2 cm for 20 times and then the required peaks were recorded.[18]

The excipients used in the formulation are also be examined by FTIR Spectrophotometry. For the identification of characteristics peaks of excipients the above method was performed. The compatibility of drug with excipients was done on the basis of interpretation of some characteristics peaks of drug with particular excipients.

**UV-Visible Spectrophotometry:**

**Selection of analytical wavelength**

The standard stock solutions is used to make the suitable dilutions of drug and scanned under UV visible spectrometer from 200-600 nm. The wavelength of herbal gel was recorded by scanned spectrum and the absorbance maxima of drug were noted down.[19]

**Preparation of standard stock solution of Herbal gel**

100 mg of herbal gel was weighed and transferred into 100 ml volumetric flask and dissolved in 10 mL of methanol as a (co-solvent), after that the flask was shaken and sonicated for 15 minutes and maintained the volume up to the mark with 6.8 pH phosphate buffer. 10 ml of solution was pipetted out from volumetric flask and then transferred it into another 100 ml volumetric flask and the 100 mL volume was maintained with 6.8 pH phosphate buffer up to the mark. The prepared concentration of stock solution was 100 µg/mL.[20]

**Selection of analytical concentration ranges**

A standard stock solution of herbal (100 µg/mL), 0.2, 0.4, 0.6, 0.8, 1.0 ml of solution were pipetted out and transferred in to individual volumetric flask of 10 mL The volume of each

volumetric flask was made up to 10 ml with 6.8 pH phosphate buffer. These concentration were made in the range of 2, 4, 6, 8 10 µg/mL respectively.[21]

For the identification of absorbance the selected wavelength of herbal gel is used and a calibration curve of absorbance vs. concentration was plotted. Herbal gel follows the Lamberts Beer's law in the range of 2-10 µg/mL

**Preparation of calibration curve**

For the quantification of herbal gel at different stages during the development and characterization of formulations, a calibration curve for drug was prepared in analytical solvent methanol as a (co-solvent) with 6.8 pH phosphate buffer. For the estimation of calibration curve, accurately weighed quantity of herbal gel (100 mg) was taken in 100 ml volumetric flask and minimum amount of solvent (methanol) was added into volumetric flask and dissolved properly. Then, volume was made up to the mark with 6.8 pH phosphate buffer[22]. After making the volume up to the mark, the solution serves as standard stock solution. From the stock solution, working standard in the range of 2-10 µg/mL was prepared by suitable dilution with respective analytical solvents. Absorbance of each working standard was measured spectrophotometrically at the respective solvent. Obtained data were recorded by using MS Excel computer software and ion and absorbance. The extinction coefficient was calculated from the slope of regression line obtained from a plot between concentrations of herbal drug.[23,]

**Formulation Studies**

**Development of poly herbal gel formulation**

Formulation of poly herbal gel containing aloe vera, f or th**e** each containing Aloe vera (3% w/w) leaf extract and the other with *Jackfruits (2.5)*% w/w. *Neem(3.0)*% w/w., *Banana peel(3.5)*% w/w, Carbopol 934 and Carbopol 940 Xanthan gum and methyl paraben, carbopol 71G NF, Glycerin, propylene glycol, Transcutol P, propyl paraben and Triethanolamine, Ethanol. Materials as per formulae given in Table (1).

For the development of poly herbal gel formulation the required quantity of all the excipients were used according to Table 1 and the drug used in each formulation was 0.1 % concentration.

Firstly, 50 ml of distilled water was taken in a clean or dry beaker and then the gelling polymer, drug, ethanol, methyl paraben and propyl paraben were added in specific amount into the beaker and dispersed with the help of magnetic stirrer. After proper stirring kept the polymer aside at normal room temperature for 24 hours swelling. After 24 hours, the required quantities of glycerin, propylene glycol, Transcutol P were added and q.s distilled water was used to make up the volume. In last, the pH of formulation is adjusted up to 5.5 with the help triethanolamine[24].

**TABLE: 1 FORMULA OF POLY HERBAL GEL**

| **Excipients** | | | | | |
|---|---|---|---|---|---|
| **(% w/w)** | **F1** | **F2** | **F3** | **F4** | **F5** |
| | **F6** | **F7** | **F8** | **F9** | **F10** |
| | **Function** | | | | |
| **Aloe Vera** | **1.5** | **2.0** | **2.5** | **3.0** | **3.5** |
| | **4.0** | **4.5** | **5.0** | **5.5** | **6.0** |
| | **API** | | | | |
| **Jackfruit extract** | **1.5** | **2.0** | **2.5** | **3.0** | **3.5** |
| | **1.0** | **2.0** | **3.0** | **4.0** | **5.0** |
| | **API** | | | | |
| **Neem extract** | **1.0** | **2.0** | **3.0** | **4.0** | **5.0** |
| | **1.0** | **1.5** | **2.0** | **2.5** | **3.0** |
| | **API** | | | | |
| **Curcumin extract** | **1.5** | **2.0** | **2.5** | **3.0** | **3.5** |
| | **4.0** | **4.5** | **5.0** | **5.5** | **6.0** |
| | **API** | | | | |
| **Banana peel extract** | | **1.5** | **2.0** | **2.5** | **3.0** |
| | **3.5** | **4.0** | **4.5** | **5.0** | **5.5** |
| | **6.0** | **API** | | | |

| Excipients (% w/w) | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aloe Vera | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | API |
| Jackfruit extract | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | API |
| Neem extract | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 1.0 | 1.5 | 2.0 | 2.5 | 3.0 | API |
| Curcumin extract | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | API |
| Banana peel extract | 1.5 | 2.0 | 2.5 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | API |
| Carbopol 934 | 1 | 1.5 | 2 | 1 | 1 | 1.5 | - | - | 1 | 1.5 | Gelling agent |
| Xanthan Gum | - | - | - | 0.5 | 1 | 0.5 | - | - | - | - | Gelling agent |
| Carbopol 940 | - | - | - | - | - | - | 1.5 | 2 | - | - | Gelling agent |
| Carbopol 71G NF | - | - | - | - | - | - | - | - | 0.5 | 0.5 | Gelling agent |
| Glycerin | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | Co solvent |
| Propylene Glycol | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | Co solvent |
| Ethanol | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | Solvent |
| Tri-ethanolamine | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | $P^H$ adjustment |
| Methyl Paraben | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | Preservative |
| Propyl Paraben | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | Preservative |
| Distt. Water | Q.S. | Q.S | Q.S | Q.S | Q.S | Q.S | Q.S | Q.S | Q.S | Q.S | Vehicle |

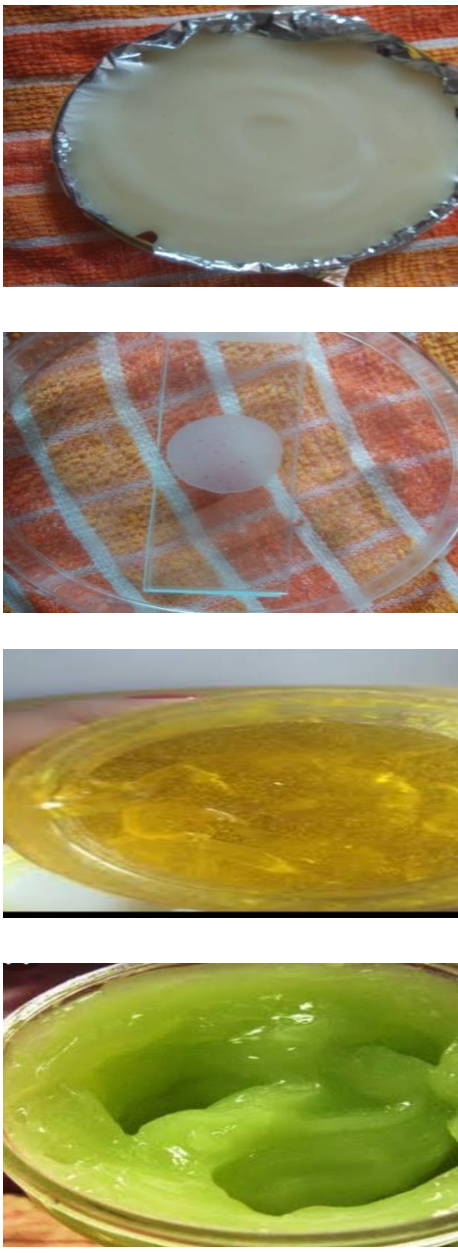

**Figure 7:** Poly Herbal gels

**Evaluation of Poly Herbal Gel**

**Physical Appearance**

Physical appearances of the formulated Poly herbal gels were evaluated by visual perception and with the help of simple microscope. The sample was placed on glass slide with the help of cover slip. Then the slide was observed under microscope and the physical appearances of gels were studied.

**Measurement of pH**

A digital pH meter is used to find out the pH of gel formulations. In a clean beaker with 50 mL of distilled water the 1 gm of gel were dissolved properly and kept it in a beaker for 2 hr's. The pH of each formulation was investigated in triplicate and the average reading was recorded.

**Viscosity**

Viscosity of gel was measured by use of Brookfield viscometer (LVDV-II+ Pro). The sufficient quantity of herbal gel was filled in sample holder separately. The height of the gel was filled in the sample holder should sufficiently allow to dip the spindle. Viscosities of the gels were recorded by adjusting the rotating speed of the spindle at 2.5 rpm.[25]

**Drug Content**

From each formulation 1 gm of gel was taken in a 100 mL volumetric flask and made up to volume by pH 6.8 phosphate buffer and shaken well to dissolve the active constituents in solvent. The solution was sonicated for few minutes and filtered it with the help of what man filter paper. After that, 0.1 mL of the filtrate was pipetted out and diluted upto10 mL with pH 6.8 buffer. The content of active constituents was estimated spectrophotometrically by using 268 nm λmax of herbal gel. The drug content present in the formulation was identified with the help of linear regression analysis of calibration curve.[26]

**Swelling Index**

For the determination of swelling index we take 1gm quantity of gel and then it was filled in a clean and dry (50 mL) beaker, the beaker hold 10 mL of distilled water. The samples were retained in a beaker for period of time and then after some time kept out the gel from beaker and put into a dry or clean place for some times and weight it again to calculate and find out how much percent of the gel was swelled[27].

We can calculate the swelling index by applying this formula:

$$SW\ (\%) = \frac{[Wt-Wo]}{W} X100$$

Where, (SW) % = % age swelling

Wt = Swollen gel weight after time (t)

Wo = Initial weight of gel

**Spreadability**

For the identification of Spreadability of gel formulations the Spreadability apparatus which contain two glass slides of (20×20 cm) is used. We take 1gm of gel and placed it on one slide. The second slide was placed over the gel and due to this the gel was pressed and spreaded between two glass slides. After that, the 100 gm of weight was placed over the top slide to press the gel freely and it will give us thin layer. The weight was removed and 20 gm weight was tied to the upper slide carefully. The total time taken by top slide and the traveled distance of slide were examined.[28] the whole procedure was performed three times and the average time of three trials was used for further calculations.

The following formula was used to find out the Spreadability:

Where, S = Spreadability

m = weight tied on top slides

l = length of the glass slide

t = time in sec.

**Homogeneity**

All the formulation of gels was stored in container and they are visually observed to identify for their appearance of any type of aggregates in the gel formulations.

**Grittiness**

The prepared formulations of gel were microscopically observed to find out the presence of any unwanted particulate. All the formulations of gel were determined for fulfill the obligation of free from unwanted particulate matter.

**Microscopic Evaluation**

The prepared formulations of gel were microscopically evaluated to check the presence of lump. This was done by

taking few quantity of gel and kept it on a glass slide and observes under microscope.

**Effect of Gelling agents**

For the formulation and characterization of herbal gel we had selected four polymers as gelling agents which include carbolpol-934, carbolpol-940, Xanthan gum, and carbopol-71G-NF. All these polymers were used in different concentration in the range of 0.5-2 %. Some of these are used in combination with each other and some were used as single gelling agent. The changes in each formulation help us to understand the behavior of gelling agents and also helpful to find out their effect in the formulation of hydrogels[29]. They were further evaluated to know their appearance, Spreadability, changes in viscosity, and swelling index etc.

***In Vitro* drug release study**

Franz diffusion cell was used to find out the invitro drug release of gel formulations. In receptor compartment pH 6.8 phosphate buffer was filled. Cellophane membrane was used as dialysis membrane. The membrane was dip inside the phosphate buffer for overnight swelling and on the donor cell compartment the membrane with gel was tied carefully. Such that the cellophane membrane was in intimate contact with the release surface of the formulation in the donor compartment. The pH 6.8 phosphate buffer was added to a donor compartment attached on the cell. A weighed quantity of formulation equivalent to 1 g of gel was taken on to the cellophane membrane and was immersed slightly in receptor media by continuously stirring. The whole experiment is done at 37±1 ºC. During the process an equal volume of sample (5 mL) was withdrawn at several intervals of time (1, 2, 3, 4, 5, 6, 7 and 8 hr) and during each withdrawn the donor compartment was replaced with equal volume of phosphate buffer. All the samples were estimated spectrophotometrically at 268 nm. The cumulative percent release was calculated for each time (in hr) interval.[30] after that the *In Vitro* drug release of selected formulations was interpreted with Zero order, First order, Higuchi and Korsmeyer Peppas kinetic models.

## RESULTS AND DISCUSSION

**Preformulation Study of Poly Herbal Gels**

**Physical Description**

The poly herbal drug is obtained in Lemon yellow, light green, light cream colored powder.

**Determination of Melting Point**

The melting point of herbal was found to be 148°C.

**Determination of pH**

The pH of the herbal gel was found to be 4.5-5.6.

**Partition Coefficient**

The standard log P value of herbal gel is 0.73 respectively and the observed value of herbal drugs was found to be 0.71. The log P value suggests that, herbal is hydrophilic in nature.

**Thin Layer Chromatography**

TLC characterization of herbal was performed by using ethyl acetate-methanol-water **(**100:13.5:10) in mobile phase and 10% ethanolic reagent as a spraying reagent to detect the colour of spot. By performing the whole TLC experiment the colour of spot and calculated Rf value of prepared plate was given in Table 2:

**Table 2: TLC Characterization of Herbal gels**

| Drug | Mobile Phase | Spraying |
|---|---|---|
| Polyherbal drugs | ethylacetate: methanol: water | |

**FTIR Spectroscopy of Herbal gels**

FTIR of herbal is considered at the range of 4000-400-1. FTIR spectra of herbal gel shows the Characteristics peak at 3677.45, 3568.46 due to OH, 2991.75, 2834.87, 2782.44 due to CH stretch in alkane, 1600.02 due to CO (carbonyl stretching), 1532.51 due to C=C (bending), 774.45, 736.84 due to CH (alkene bending) and 1188.20, 1171.81, 1166.02 due to ether medium. The ranges of peaks in the IR spectrum verify the occurrence of various functional groups as compare to the standard spectrum in Figure 1 (a), which confirm the purity of the herbal gel. In the IR spectrum of herbal gel with excipients used in the preparation of formulations, we examined that the

observed frequencies of herbal are in the standard frequencies range in Figure 1 (b) with their characteristics functional groups

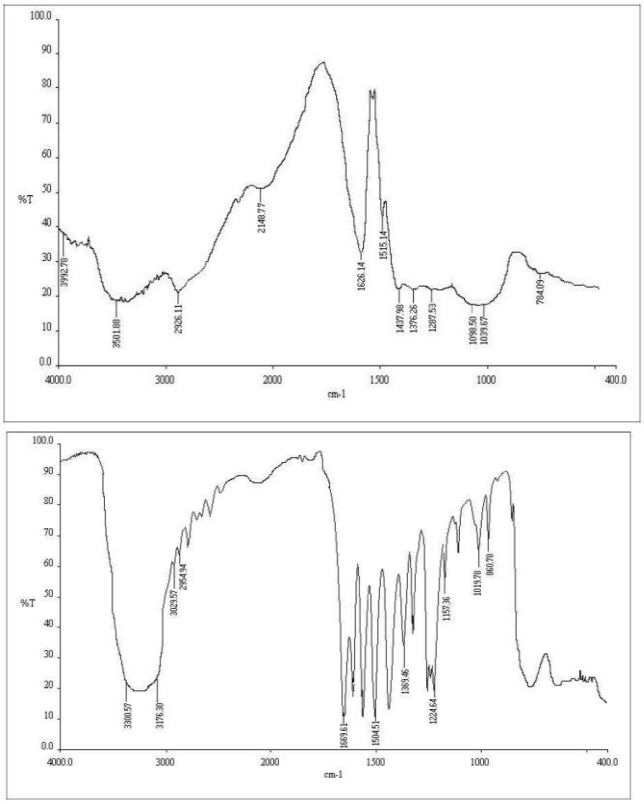


**Figure 8 (a): IR Spectrum of Banana peels powder, (b) IR Spectrum of Herbal drug with Excipients Used in the preparation of Formulations.**

**UV-Visible Spectrophotometry of Herbal gel**

**Selection of analytical wavelength**

The wavelength of herbal gel was carried out by preparing the dilutions at different concentration and the λmax of herbal gel was selected as 268 nm for final results. The spectrum has been shown in Figure 2 respectively.

**Linearity Curve of herbal gel**

The linearity of herbal gel was found at the concentration range of 2-10 µg/mL at 268 nm. The R2 value was at 0.999 respectively. The linearity curve was made with concentration (µg/mL) on X axis and Absorbance on Y axis in Figure 8

**Table 3: Result of Linearity Curve of herbal gel**

| S.No | Concentration (µg/mL) | Absorbance |
|---|---|---|
| | 2 | 0.095 |
| 2. | 4 | 0.189 |
| 3. | 6 | 0.289 |
| S.No | Concentration (µg/mL) | Absorbance |
| 1. | 2 | 0.095 |

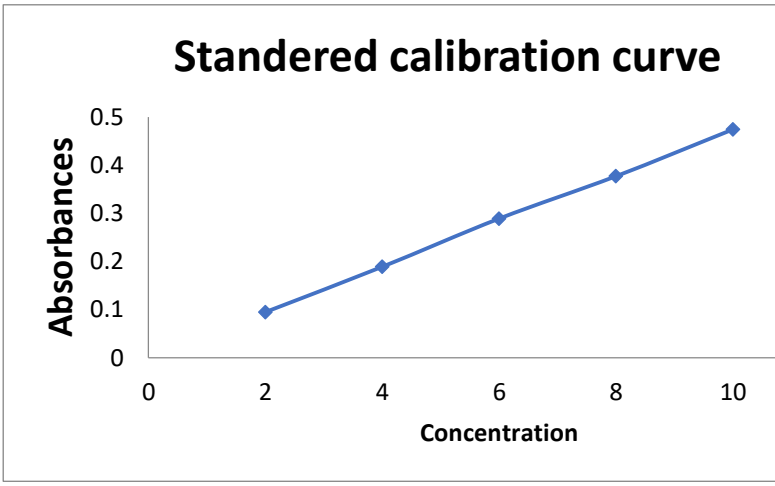


**Figure 9: UV-Vis Spectrum of herbal gel (8 µg/ml)**

**Characterization of Gel formulation**

The gel formulation of herbal gel was prepared successfully. For the evaluation parameter of gel formulation the different type of tests are performed (appearance, homogeneity, grittiness, pH, Spreadability, microscopic evaluation, viscosity, drug content, swelling index etc.) were performed to identify and get the best optimized formulations from (F1-F10). The optimized formulations were used in our research work

**Table 4: Evaluation parameters of poly herbal gel formulations for psoriasis treatment**

| Formulations | Appearance | Homogeneity | Grittiness | pH | Spreadability (gm/sec) | Microscopic evaluation | Viscosity (cps) | Drug content (%) | Swelling index (%) |
|---|---|---|---|---|---|---|---|---|---|
| **F1** | Light Yellow | + + + | No | 5.5±0.06 | 23.008±0.0218 | No Lumps | 37325 | 96.9 | 63 |
| **F2** | Light Yellow | + + + + | No | 5.6±0.07 | 18.035±0.0325 | No Lumps | 41500 | 98.2 | 77 |
| **F3** | Yellow | + | Yes | 5.3±0.06 | 13.062±0.0175 | Lumps | 47348 | 93.6 | 89 |
| **F4** | Light yellow | + + + + | No | 5.4±0.06 | 22.038±0.0316 | No Lumps | 42257 | 99.2 | 75 |
| **Formulations** | **Appearance** | **Homogeneity** | **Grittiness** | **pH** | **Spreadability (gm/sec)** | Lumps | 49582 | 94.7 | 81 |
| **F1** | Light Yellow | + + + | No | 5.5±0.06 | 23.008±0.0218 | No Lumps | 46241 | 95.2 | 83 |
| **F2** | Light Yellow | + + + + | No | 5.6±0.07 | 18.035±0.0325 | No lumps | 43523 | 98.6 | 78 |
| **F3** | Yellow | + | Yes | 5.3±0.06 | 13.062±0.0175 | Lumps | 52428 | 96.8 | 90 |
| **F4** | Light yellow | + + + + | No | 5.4±0.06 | 22.038±0.0316 | No Lumps | 36495 | 94.4 | 69 |
| **Formulations** | **Appearance** | **Homogeneity** | **Grittiness** | **pH** | **Spreadability (gm/sec)** | No Lumps | 41422 | 98.2 | 74 |

**Note: *Average of three trials, + + + + very good; + + + good; + + average; + poor**

**Effects of Gelling agents in Formulations**

**Effect of Carbopol 934**

In the preparation of topical formulation of herbal gels we are using carbopol 934 in the concentration range of F1 (1%), F2 (1.5%), F3 (2%). The physical appearance of these formulation show good color properties from light yellow to yellow. The viscosities were high in formulation F3 as compare to F1 and F2, because by increase in the concentration of polymer the viscosity of gel was also increased. The swelling property of carbopol 934 is depending on the concentration of gelling agent, the swelling property of F2 and F3 is more than F1. The swelling of gel formulation were increase as the concentration of carbopol 934 increases. At low concentration of polymer in F1 Spreadability is increased, while F2 and F3 will gradually decrease in the Spreadability. From all these three formulation the physical appearance of F2 was good, and it will show impressive results by microscopic evaluation.

**Effect of Carbopol 934 in Combination with Xanthan Gum**

Xanthan gum is used to prepare the herbal gel in combination with carbopol 934. Both the polymers are used in various concentration ranges in herbal gel formulation, F4 (carbopol 934-1%/Xanthan gum-0.5%), F5 (carbopol 934-1%/Xanthan gum-1%), F6 (carbopol 934-1.5%/Xanthan gum-0.5%) were used. The physical appearances of F4, F5 and F6 were identified at light yellow to yellow in color gel. By increasing the concentration of Xanthan gum in combination with carbopol 934 it will increase their viscosity and quite decrease in Spreadability of formulation F5 and F6. The swelling behavior of all three formulations was different, while higher percentage of swelling in F5 and F6 was observed, this is because of the high concentration of both the gelling agents. By combining F4, F5 and F6 formulation F4 show good results of physical appearance as well as good viscosity, Spreadability and swelling property.

**Effect of Carbopol 940**

Carbopol 940 is used in formulation F7 (1.5%) and F8 (2%) as a single gelling agent. By comparing the results of this gelling agent at different concentration we will find that formulation F8 show higher range of viscosity and gradually decrease in their Spreadability. The swelling property of F8 is higher than that of F7. At the concentration range of 1.5% in F7 the viscosity and Spreadability was quite good as compare to F8. By comparing carbopol 940 as a single gelling agent with F2 and F3 (1.5-2% carbopol 934), we will find that carbopol 940 in the concentration of 1.5% had good physical appearance by microscopical evaluation and the consistency of F7 formulation was good.

**Effect of Carbopol 934 in combination with Carbopol 71G NF**

Carbopol 71G NF in same concentration range was used in combination with different concentration of carbopol 934. In formulation F9 (Carbopol-1% /Carbopol 71G NF-0.5%) and F10 (carbopol 934-1.5%/carbopol 71G NF-0.5%) were used. All these three formulation were made by varying the concentration range of carbopol 934 and same equal concentration of carbopol 71G NF is added in both the

formulations. The viscosity of F9 is less as compare to F10, and a minute change was observed in the Spreadability of F9. Both these formulations show quite similar swelling property, but difference is observed in the viscosity or Spreadability. By physical evaluation the consistency and appearance of F10 formulation was good and it will show good results as compare to F9.

According to the comparative study of the formulations from F1-F10 it has to be identifying that the formulation F2, F4, F7 and F10 show good evaluation results as compare to other formulations. Furthermore, these four optimized formulation are selected for the higher evaluation studies (*In Vitro* drug release) on the basis of their optimum viscosity, Spreadability, swelling property as well as their good physical appearances.

### *In Vitro* drug release study

The selected formulations with code F2, F4, F7 and F10 are experimented by *In Vitro* to identify the drug release of selected hydrogel formulation. All the selected formulations are further evaluated by kinetic study and the four kinetic models are used (zero order, first order, higuchi, Korsmeyer Peppas). The obtained results of released drug are tabulated and represented graphicallyinFigure3.

**Table 5: *in Vitro* Drug Release study from Selected Formulations**

| S.No. | TIME (hr's) | F2 | F4 | F7 | F10 |
|---|---|---|---|---|---|
| **1.** | 0 | 0 | 0 | 0 | 0 |
| **2.** | 1 | 17.34 | 10.35 | 9.32 | 14.83 |
| **3.** | 2 | 29.23 | 17.32 | 15.21 | 27.31 |
| **4.** | 3 | 40.2 | 25.31 | 23.59 | 40.59 |
| **5.** | 4 | 55.41 | 33.81 | 31.2 | 54.27 |
| **6.** | 5 | 66.32 | 46.32 | 40.28 | 67.21 |
| **7.** | 6 | 74.12 | 54.44 | 48.65 | 76.65 |
| **8.** | 7 | 81.42 | 62.23 | 57.11 | 84.66 |
| **9.** | 8 | 92.25 | 69.53 | 65.54 | 89.51 |

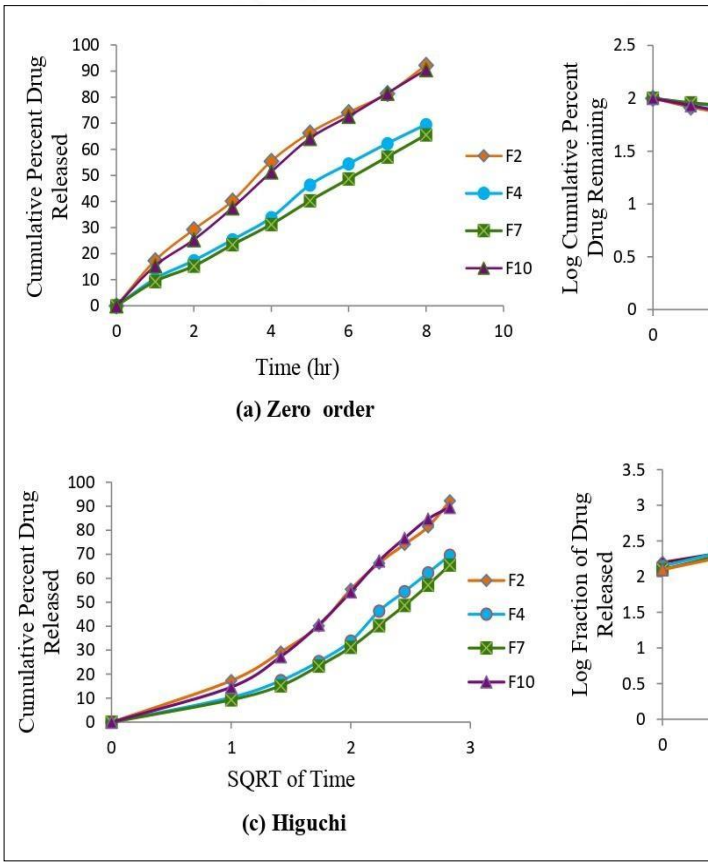


**Figure 10: (a) Zero order release profile, (b) First order release profile, (c) Higuchi release profile, (d) Korsmeyer Peppas release profile.**

**Table 6: Kinetics of *In Vitro* Release from Selected Formulations**

| Formulations Code | Zero order $R^2$ | First order $R^2$ | Higuchi $R^2$ |
|---|---|---|---|
| F2 | 0.987 | 0.930 | 0.956 |
| F4 | 0.997 | 0.975 | 0.912 |

| | | | | | |
|---|---|---|---|---|---|
| **F7** | 0.998 | 0.970 | 0.904 | 0.930 | 0.981 |
| **F10** | 0.993 | 0.971 | 0.948 | 0.9 | 0.997 |

For the identification of release mechanism the drug release data were explored by kinetic models. The best fit of kinetic model is noticed by observing the R2 value of each formulation. In which the highest R2 coefficient was observed by both Higuchi and first order models followed by zero order model which showed the drug release by diffusion mechanism.

Diffusion, swelling and erosion are the three main important mechanisms for controlled and sustained release formulations. The release of drug by polymeric system is generally by diffusion and best described by Fickian diffusion. The formulations which include the swelling of polymers, relaxations of polymer chain, imbition of water causing polymers by allowing to swell and change their state from initial glassy to rubbery. Appropriate swelling and significant degree of expansion takes place will lead to moving the diffusion boundaries, complicating the solution of Fick's second law of diffusion.

The n value of all formulations was (F2-0.8), (F4-0.9), (F7-0.8) and (F10-0.9). From these values all the formulations showed non Fickian drug release mechanism shown in Table 6. Therefore, from the above release study parameters formulation F2 and F10 show the best optimized release characteristics as compare to the selected optimized formulations F4 and F7.

## CONCLUSION

Psoriasis is a chronic inflammatory skin condition and immune mediated ailment. The prevalence of psoriasis occurs worldwide. In the treatment of skin diseases the best method for the delivery of drugs is through topical route. Herbal gel formulations of Jackfruit, Banana Peel, and Aloe Vera, Neem, Curcumin *extract* were prepared with an objective of increasing the skin permeation of drugs and effective to improve the efficacy of topical application for psoriasis. Multiple polymers in single and with combination were used to prepare the formulations of herbal gel. Herbal gels composed of carbopol 934, Xanthan gum, carbopol 940 and carbopol 71G NF polymers, glycerin, propylene glycol, ethanol, Transcutol P and triethanolamine were prepared desirable gel characteristics good efficacy of the topical delivery of herbal drugs. The prepared formulations were evaluating for their physical appearance, pH, viscosity, Spreadability, grittiness, homogeneity, swelling index and drug content. In our study we find that formulation F2, F4, F7 and F10 show good gelling properties with concern to the above evaluation parameters. By comparing the all formulations of herbal gel they are further evaluated for in vitro drug release study, in which the formulation F2 and F10 showed highest release in 8 hr's. The kinetics of invitro drug release showed that, the F2, F4, F7 and F10 formulations had good release kinetics and showed non fickian drug release as the n value was between 0.8 to 0.9. From these release parameters, formulations F2 and F4 showed highest release of herbal drugs in 8 hr's. These results suggest the improvement of efficacy of topical gel for the treatment of psoriasis. The enhanced efficacy of herbal gel is due to increased penetration of drugs from hydrogel than conventional formulations