Development And Evaluation Of Topical Nanosponges Based Gel Containing Caffeine

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ABSTRACT: A Topical drug conveyance framework is a method for conveying a prescription that is applied on to a specific part of the body, ordinarily the skin, to treat different diseases. Nanosponges act for the purpose of demonstrative devices or to convey restorative specialists to explicitly designated destinations in a controlled way, particularly for ineffectively water-dissolvable medications like caffeine. Nanosponges are little circular particles containing depressions where drug atoms can be put away. The caffeine nanosponges were ready by emulsion dissolvable dispersion technique, utilizing different extents of caffeine(drug): ethylcellulose(polymer) disintegrated in 20ml of dichloromethane and gradually added to the distinct measure of polyvinyl liquor in 100ml of the fluid nonstop stage. The response blend is saved for mixing at 1000 rpm for 2 hrs. Nanosponges were ready for the drug: polymer proportion of 1:1, 1:0.25, 1:0.50, 1:0.75, 1:1.25, 1:1.50. Arranged nanosponges were assessed for weight consistency, molecule size examination, disintegration testing, and microscopy. The nanosponges were additionally figured out into an effective gel by utilizing carbopol 940 polymer. The gel was assessed based on spreadability, consistency, scent, variety, in vitro discharge, and steadiness. From the review, it was presumed that the gel displayed palatable dependability and promising medication discharge. The definition was viewed as a reasonable possibility for the improvement of nanosponges stacked skin gel for helpful use in the treatment of cellulite.

Index Terms:- Cellulite, nanosponges, particle size analysis.

INTRODUCTION

What are Nanosponges?

- Nanosponges are small Sponges with a size about infection with a typical measurement underneath 1nm comprising of holes that can be loaded up with a wide assortment of medications
- Sponges go about as a three-layered or seatfold which comprise of the spine known as "Long-length Polyester" which is strong in nature.
- Nanosponges is a Novel and Arising innovation that assumes a significant part in focusing on drug conveyance in a controlled way which can be figured out in oral, parenteral, skin, or inward breath dose structure.
- A portion of the properties of nanosponges is that they are non-harmful, non-aggravation, have high viability, and give support the arrival of medications.

Application of Nanosponges in Topical Drug Delivery

- The expanded reception of skin prescription as of late has been noteworthy. This is generally because of the way that the medicine has demonstrated more invaluable than an issue. Skin drug conveyance is essentially planned for a nearby impact, where it can - decrease askew secondary effects, expand the complete portion expected to arrive at the designated site, and possibly take out the requirement for foundational flow.
- The skin area offers drugs for fundamental medication conveyance for broadened times of time. As the skin is the biggest organ it is great for drug organization and produces both foundational and nearby results. The treatment of a few skin conditions can be handily managed through neighborhood conveyance of the medication.
- Nanosponges are tiny particles with holes. They can be stacked with a wide assortment of hydrophilic as well as lipophilic medications. Nanosponges can give a nearby activity to a specific region. They can deliver the medication particle in an anticipated style like for a lengthy time of 6 - 12hrs.
- The polymers utilized in the nanosponges are biodegradable subsequently they are ecologically positive.
- Furthermore, they are likewise tolerant consistent, non-bothering, non-mutagenic, and non-ionic
Use of Caffeine in Topical Drug Delivery as Nanosponges

- Caffeine is a characteristic alkaloid with a compound Formula of C8H10N4O2. It can contract the vein and assist with diminishing aggravation and puffiness. Likewise, it additionally fixes, lights up, and smoothes away cellulite.
- It has various pharmacological and physiological impacts including, cardiovascular, respiratory, renal, and smooth muscle impacts, as well as consequences for the state of mind, memory, sharpness, and physical and mental execution. It is a white translucent powder that is monohydrate in nature, scentless, and should be safeguarded from light and dampness.
- The pharmacological impacts of caffeine are like those of other methylxanthines (remembering those found for different teas and chocolates). These impacts incorporate gentle CNS excitement and attentiveness, capacity to support scholarly action, and diminished response times. Peak plasma focus happens somewhere in the range of 15 and 120 minutes after oral ingestion.
- With rehashed caffeine dosing, paraxanthine may add to the advancement of resistance and withdrawal side effects. Caffeine leeway rates are impacted by both natural and physiological elements, like utilization of smoking, oral contraceptives, and pregnancy. Resistance to a portion of caffeine's physiological impacts creates with proceeded with use.
- Adenosine is a substance which causes languor as it joins to the adenosine receptor showing neuron transmission. Caffeine is comparable in design to caffeine so it connects to the adenosine receptor. This takes up the receptors from normal adenosine, not permitting the body to become drained. This confounds the cerebrum and frequently makes adrenaline stream frequently causing expanded sharpness.
- Indeed, even in the wake of enjoying endless benefits, it is effectively accessible at an extremely modest expense. Right now there are numerous products of caffeine accessible for its magnificent corrective purposes yet there are still a few circumstances which have not been thought about while discussing caffeine. One of such circumstance is Cellulite.

What is Cellulite?

- Characterized as a skin condition having fat kept under the skin. It is an innocuous skin condition. The principal side effect is the presence of uneven, dimpled tissue on the thighs, hips, posterior, and stomach.
- FACT:- Cellulite is Not quite the same as Fat. Medicines that can eliminate fats frequently affect cellulite.
- It has been accounted for by by in excess of 10 million individuals in India each year.

Causes of Cellulite

Cellulite influences the subcutaneous layer of the skin or the dermis. This is the layer underneath the skin. To comprehend how the treatment of cellulite functions we should figure out the construction and capability of dermis. The dermis is an organization of sinewy connective tissue that gives versatility and elasticity to the skin. These interface the skin to the muscle layer beneath. The singular parts of connective tissues are collagen, flexible strands, lymph and veins, and fat tissue. Subsequently, when the fat tissue develops or increments, they push the skin outwards the long, intense connective tissues get pulled outwards. This causes lopsided and uneven skin which adds to improvement of cellulite.

Causes:-

- **Hormonal changes:** Chemicals are the primary driver for improvement of cellulite particularly during adolescence, pregnancy and menopause. Water maintenance, unfortunate dissemination, and end of poisons follow, causing a swelling "sewed" appearance on the skin surface.
- **Age:** Collagen is a protein present in the body that guarantees solidity, gracefulness, union, and hydration to the skin. From the age of 25, the normal creation of collagen dials back steadily. The outer layer of the skin is debilitated and relaxes, complementing the presence of cellulite.
- **Physiognomy:** The construction of fat tissue which stores fat cells vary for men and women. When there is an expansion in the fat put away they are constrained vertical and are packed between parts -, for example, balls compacted in a net. This is the way an inconsistency is made on the outer layer of the skin.
- **Other:** Hereditary elements, Way of life, Dietary, Weight gain, Collection of poisons

Stages of Cellulite

Stage 1: Is the sort of cellulite that you can't understand while standing up, however, when you squeeze the skin, it shows up as kinks, not dimples.
Stage 2: Is comparative aside from the way that, when you squeeze the skin, you see dimpling rather than wrinkles.
Stage 3: Dimples can be seen on the bottom, gut or thighs while standing, yet not when you loosen up the skin and body.
Stage 4: Dimples are perceptible whether you're loosening up, and at times, you might encounter agonizing cellulite.

Types of Cellulite

- Delicate Cellulite:- Otherwise called limp cellulite, delicate cellulite is related with hanging skin and is in many cases tracked down on body regions where fat amasses, like the arms, stomach, hips, backside, and legs. It is more apparent when you are resting instead of standing.
- Hard cellulite:- Hard or conservative cellulite is the reason for what is conversationally known as an 'orange strip'. This sort of cellulite can influence all individuals, including thin and conditioned individuals. It is described by dejections and flaws on the thighs, glaciers, and hips. Serious cases can feel extremely hard and agonizing to the touch.
Edematous Cellulite:- Otherwise called unfortunate dissemination cellulite, edematous cellulite is the most un-normal type of cellulite and can be exceptionally difficult to treat. It results from unfortunate blood dissemination which is exasperated by liquid maintenance.

Clinical manifestation of cellulite

DIAGNOSIS: As like some other clinical conditions, a precise determination is significant prior to beginning the administration of cellulite.

Cellulite has clinical elements like dimpled or rough skin. It is portrayed as an orange strip of surface skin. Gentle cellulite should be visible in the thighs if somewhat squeezed.

Available treatment for Cellulite

- Cellulite Laser Treatment
- Acoustic Wave Treatment (AWT)
- Liposuction
- LPG Endermologie
- Radiofrequency
- Low-Level Laser Treatment
- Mesotherapy
- Rubs

Despite the fact that there are a few choices accessible for the treatment of cellulite they are not reasonable by all. The treatment costs are incredibly high and some are agonizing as well. These strategies can likewise have added aftereffects to these medicines.

Prevention of Cellulite

Despite the fact that cellulite is an innocuous condition there are multiple ways of forestalling the condition, for example,

- Keeping a steady weight
- Eating a decent eating routine
- Keeping yourself dynamic
- Staying Hydrated
- Kneading

LITERATURE REVIEW

1. A Vyas, et al. (2010) developed cyclodextrin-based nanospheres of cefadroxil which are used in skin, throat, and urinary tract infections. The particle size of the nanosphere complex is found between 690 To 800 nm with low polydispersity indices.
2. Roberta C, et al. (2010), formulated nanospheres as oxygen delivery systems with three types of cyclodextrin. Their ability to release oxygen in the presence and the absence of ultrasound is to be determined over time. Oxygen permeation through a silicone membrane was obtained using a cyclodextrin nanosphere/hydrogel combination system.
3. Chander PD, et al (2010) described the method of nanoparticulate material using Glibenclamide different polymers and surfactants at varying ratios. The dissolution studies were performed and were within the IP limits and various analytical tools with which it was reported that the formulations were found to show reduced side effects, improved patient compliance, and reduced dose frequency.
4. E. K. Patel, et al (2012) the nanosphere and microsphere delivery system was originally developed for topical delivery of drugs and can also be used for controlled oral delivery of drugs using water soluble and bio erodible polymers. They found nanospheres entrap a wide range of drugs and then release them onto the skin over time and also in response to other stimuli including rubbing, moisture, pH, friction, or ambient skin temperature.

AIM AND OBJECTIVE OF THE STUDY

Aim:- The development and evaluation of topical nanospheres-based gel containing caffeine.

Objective:-
1)To complete the Writing Overview
2)To complete Preformulation Studies
3)To plan the Nano sponges gel by Utilizing Caffeine
4)To assess the last measurement structure

Rationale:- Cellulite is a condition of stress in the creating scene, especially for females, and needs more thought for its treatment which shows limitation reliable, non-exacerbation, easy to apply, and sensible with least optional impacts. The establishment survey shows that there is no compelling estimation structure with upheld release and assigned movement of caffeine to the going condition. Thus, our place of the errand is to encourage caffeine-stacked nanospheres which could be used for skin association with the upheld appearance of the drug for the treatment of cellulite.
MATERIALS AND METHODS

The drug Caffeine was procured and various trimmings like the polymer(ethylcellulose, PVA), and dichloromethane were obtained from Pharm Chem Lab. Method for the plan of nanosponges was recorded from studied articles and was finished using different extents of polymer and prescription to check which extent gave the nanosponges of most desirable characteristics. Further, the nanosponge with the most desirable characteristics was framed into the gel using an essential gel preparation philosophy. Carbopol 940 was used as a gelling expert which gives the best clear gel. The gel was surveyed for smell, assortment, consistency, immersion, and steadfastness.

- Procedure for progression of Nanosponges (Alluring Blending)
An appealing stirrer is a device by and large used in labs and contains a turning magnet or a decent electromagnet that makes a turning alluring field. This device is used to make a blend bar, soak in a liquid, quickly wind, or mix or mix a response. This is a very calm contraption and appreciates the phenomenal advantage of blending in a shut structure. Because of the small size of the alluring bar, they can be easily cleaned and sanitized when diverged from glass posts. In an appealing stirrer, the watery stage turns continually including a bar of magnet as a stirrer to which when the normal stage is added dropwise. Late evening of turning roundabout particles are gotten dealing with the polymer by the drug.
Steps experienced in the process can be set up into stages:-
- First is the status of the liquid stage that consolidates PVA broke down in water.
- Second is the preparation of a characteristic stage containing the medicine and polymer in different extents and dissolving in dichloromethane.
- The third stage is the mixing of the two stages. The mixing in the third stage can be either directly mixing the normal stage into liquid or the regular stage can be added dropwise
Active pharmaceutical Excipient:-
Caffeine

<table>
<thead>
<tr>
<th>Color</th>
<th>White powder or silky needles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solubility</td>
<td>Insoluble in water, completely soluble in chloroform, ethyl acetate, pyridine</td>
</tr>
<tr>
<td>Melting Point</td>
<td>227° to 228° C</td>
</tr>
<tr>
<td>Therapeutic use</td>
<td>To treat various dermatological conditions, postprandial hypotension and obesity, enhance seizure duration in electroconvulsive therapy</td>
</tr>
</tbody>
</table>

Structure

Excipients Used:-
(All the excipients used are of Laboratory Grade)

1. Ethylcellulose
   Description: Ethylcellulose is insoluble in water and liquids so blended in with water dissolvable added substances to solubilize it. The polymer is generally natural and dissolvable in unmistakable solvents, boring, dismal, and non-toxic. EC can endure the arrival of drugs. It is a subsidiary of cellulose where a portion of the hydroxyl bunches on the rehashing glucose units are changed over into ethyl ether gatherings. Drugs delivered through ethylcellulose-covered dose structures can be restrained by dispersion through the film covering. This can be a sluggish interaction except if a huge surface region is used. In those examples, fluid ethylcellulose scattering is by and large used to cover granules or pellets. Ethylcellulose-covered globules and granules have additionally shown the capacity to retain pressure and consequently shield the covering from breaking during pressure.

<table>
<thead>
<tr>
<th>Formula</th>
<th>( C_{20}H_{38}O_{11} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting Point</td>
<td>240° to 255° C</td>
</tr>
<tr>
<td>Density</td>
<td>1.45 g/cm³</td>
</tr>
<tr>
<td>Boiling Point</td>
<td>654.2° C</td>
</tr>
</tbody>
</table>

Structure

2. Carbopol 940
   Description: It is an incredibly effective rheology modifier equipped for giving high consistency and structures shimmering clear gels or hydro-alcoholic gels and creams. Carbomer is the market name of polyacrylate polymer. There are various sorts of carbomer materials in light of their synthesis and applications. This material is fit for giving high consistency, superb thickening properties, and high suspending execution in a low portion. It is extremely valuable in the creation of clear gels, hydroalcoholic gels, creams, and so on, because of its non-dribble, short-stream properties. We can get shining clear water or hydroalcoholic gels and creams after killing this material.

Structure
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<table>
<thead>
<tr>
<th>Formula</th>
<th>(C₃H₄O₂)ₙ</th>
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</thead>
<tbody>
<tr>
<td>Melting Point</td>
<td>12.5°C</td>
</tr>
<tr>
<td>Density</td>
<td>1.2 g/cm³</td>
</tr>
<tr>
<td>Boiling Point</td>
<td>502.0°C</td>
</tr>
</tbody>
</table>

Structure

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<td></td>
</tr>
</tbody>
</table>
```

**FORMULATION- PREPARATION OF NANOSPONGES**

Composition of different Nanosponges Gel formulation containing Caffeine.

**Preparation Of Nanosponges**

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>A(1:1)</th>
<th>B(1:0.25)</th>
<th>C(1:0.50)</th>
<th>D(1:0.75)</th>
<th>E (1:1.25)</th>
<th>F(1:1.50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caffeine</td>
<td>1200mg</td>
<td>1200mg</td>
<td>1200mg</td>
<td>1200mg</td>
<td>1200mg</td>
<td>1200mg</td>
</tr>
<tr>
<td>Ethylcellulose</td>
<td>1200mg</td>
<td>300mg</td>
<td>600mg</td>
<td>900mg</td>
<td>1500mg</td>
<td>1800mg</td>
</tr>
</tbody>
</table>

**Procedure:**

The Nanosponges Gel was prepared by:

1. The dose of the drug was decided to be 1200mg.
2. Drug: polymer(ethylcellulose) in the ratio of 1:1 were weighed and kept separately.
3. Preparation of organic phase:-
   - 20 ml of dichloromethane was taken in a small beaker and covered with aluminum foil. The weighed drug and polymer were added to the above beaker and mixed with a glass rod.
4. Preparation of aqueous phase:-
   - The polymer(polyvinyl alcohol) taken for aqueous phase was 0.5% of water(100 ml). The polymer was dissolved in water and to completely dissolve heating is required.
5. Put the aqueous phase on the magnetic stirrer at 1000 rpm followed by the addition of organic phase drop by drop. It is then kept on the magnetic stirrer for 2 hrs.
6. After 2 hrs the solution is removed from the stirrer and is filtered using the Buchner funnel.
7. The particles on the filter paper collected are the Nanosponges.
8. The same above procedure is followed for different ratios of the drug: polymer [1:0.25, 1:0.50, 1:0.75, 1:1.25, 1:1.50]
9. The collected nanosponges from all different ratios are compared.

**Results:**

1. The Nanosponges obtained by the above technique for the proportion 1:1 were viewed as circular, uniform, and of ideal quality.
2. While the nanosponges acquired from the proportions of 1:0.75, 1:1.25, 1:1.50 were viewed as of misshaped shape and enormous size.
3. No nanosponges were acquired for the proportions 1:0.25 and 1:0.50.
EVALUATION OF NANOSPONGES

1) Microscopic Test:
   Procedure:
   Put a few drops on a glass slide and 1-2 drops of liquid paraffin and observe under a microscope for ration
   Observation:
   Minute qualities of 1:1 nanosponges show a round shape and particles are very much isolated from one another.

2) UV-Visible Spectroscopy:
   Drug-10 ppm:
   Nanosponges 10ppm:

   Observation:
Since nanosponges have lower peaks as compared to drugs at 10 ppm it shows entrapment of the drug.

3) Dissolution Test:-

Procedure:-
1. 10mg of the drug is dissolved in a 1000ml dissolution medium (distilled water) and the dissolution is started. [Set the dissolution apparatus as follows: RPM - 10, Temp - 37.5 °C.]
2. Collect 10ml of sample solution and replace it with 10ml of distilled water after every 1hr.
3. The dissolution test was conducted for 6 hrs.
4. The same procedure of dissolution test was performed for all the nanosponges obtained from changing drug: polymer ratios.

Observation:

<table>
<thead>
<tr>
<th>The ratio of drug: to polymer</th>
<th>1hrs</th>
<th>2hrs</th>
<th>3hrs</th>
<th>4hrs</th>
<th>5hrs</th>
<th>6hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:0.75</td>
<td>0.202</td>
<td>0.133</td>
<td>0.197</td>
<td>0.179</td>
<td>0.087</td>
<td>0.108</td>
</tr>
<tr>
<td>1:1</td>
<td>0.113</td>
<td>0.231</td>
<td>0.158</td>
<td>0.181</td>
<td>0.159</td>
<td>0.166</td>
</tr>
<tr>
<td>1:1.25</td>
<td>0.74</td>
<td>0.152</td>
<td>0.237</td>
<td>0.136</td>
<td>0.102</td>
<td>0.134</td>
</tr>
<tr>
<td>1:1.50</td>
<td>0.113</td>
<td>0.219</td>
<td>0.182</td>
<td>0.186</td>
<td>0.147</td>
<td>0.074</td>
</tr>
</tbody>
</table>

Calculations:

<table>
<thead>
<tr>
<th>Concentration of drug dissolved in methanol (ppm) [x]</th>
<th>Absorbance [y]</th>
<th>xy</th>
<th>x²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.132</td>
<td>0.264</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>0.229</td>
<td>0.916</td>
<td>16</td>
</tr>
<tr>
<td>6</td>
<td>0.315</td>
<td>1.39</td>
<td>36</td>
</tr>
<tr>
<td>10</td>
<td>0.553</td>
<td>5.53</td>
<td>100</td>
</tr>
<tr>
<td>Total=22</td>
<td>Total=1.229</td>
<td>Exy=8.67</td>
<td>Ex²=156</td>
</tr>
<tr>
<td>Mean(x)=22/4</td>
<td>Mean(y)=1.229/4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>=5.5</td>
<td>=0.30725</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By Linear Regression Method

\[ m = \frac{n(Exy) - ExEy}{nEx^2 - (Ex)^2} \]

\[ c = (mean \ of \ y) - m(mean \ of \ x) \]

\[ y = mx + c \]

\[ y = 0.0546x + 0.0067 \]

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>Absorbance</th>
<th>Amount of drug</th>
<th>Amount of drug</th>
<th>Amount in 900ml</th>
<th>CR</th>
<th>% CR = CRx100</th>
<th>% Retained =100-%CR</th>
</tr>
</thead>
</table>

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Result:
The dissolution of the 1:1 ratio is the best among all ratios of nanosponges.

4) Particle Size Analyzer (PSA):
A particle analyzer was used for the determination of the size and distribution of particles

Result:- As the size of the nanosponges formed was found to be 42.05 nm it is of optimal quality.

FORMULATION- PREPARATION OF NANOSPONGE GEL
Preparation Of Nanosphges gel
As nanosponges formed from a 1:1 ratio were of optimal quality these were used for the formulation of topical gel.

Formula Table:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity (100g)</th>
<th>given</th>
<th>Quantity (15g)</th>
<th>taken</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanosponges</td>
<td>1g</td>
<td></td>
<td>0.15g</td>
<td></td>
<td>Anti Inflammatory, cellulite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>reduction, UV Protection</td>
</tr>
<tr>
<td>Propylene glycol</td>
<td>20g</td>
<td></td>
<td>2g</td>
<td></td>
<td>humectant</td>
</tr>
<tr>
<td>Carbopol</td>
<td>1g</td>
<td></td>
<td>0.15g</td>
<td></td>
<td>Gelling Agent</td>
</tr>
<tr>
<td>Triethanolamine</td>
<td>q.s. to pH 7</td>
<td></td>
<td>q.s. to pH 7</td>
<td></td>
<td>Alkalizing agent</td>
</tr>
</tbody>
</table>
### p-hydroxybenzoic acid (Parabene)

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-hydroxybenzoic acid</td>
<td>0.02g</td>
<td></td>
<td>Preservative</td>
</tr>
<tr>
<td>Distilled water</td>
<td>q.s. 100g</td>
<td></td>
<td>Vehicle</td>
</tr>
</tbody>
</table>

### Procedure:

1. Weigh Carbopol 940 and Disperse in Distilled Water and keep for 20-30 minutes. (Use 2/3rd of distilled water)
2. Dissolve Caffeine Nanospheres in Propylene glycol then add the remaining quantity of distilled water.
3. Add Drug Solution to Carbopol of Solution with slow stirring. (Vigorous stirring should be avoided to prevent entrapment of air bubble)
4. Add Triethanolamine dropwise until the pH is 7.
5. Label and dispense the desired amount of gel in a collapsible tube.

### EVALUATION OF NANOSPONGE GEL

#### 1) Franz Diffusion Cell

**Procedure:**

1. Diffusion medium pH 7.4 phosphate cushion was ready and filled into the receptor chamber.
2. The channel was connected to the regular water and the power source of the circulator was left open to keep up with the temperature.
3. Cellophane (Natural semi-porous layer) was chosen for the testing of saturation. The caffeine nanosponge gel was applied on one side of the semi-penetrable film.
4. The semi-porous layer was put between the giver chamber and the receptor chamber.
5. The example of 1ml was gathered from the testing port after each 1hr and supplanted with 1ml of diffusing mechanism for 6hrs.
6. The gathered example arrangements were weakened with 9ml of refined water and the absorbance was accounted for.

**Observation Table:**

<table>
<thead>
<tr>
<th>Time(hr)</th>
<th>Absorbance(nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>0.015</td>
</tr>
<tr>
<td>3</td>
<td>0.021</td>
</tr>
<tr>
<td>4</td>
<td>0.036</td>
</tr>
<tr>
<td>5</td>
<td>0.049</td>
</tr>
<tr>
<td>6</td>
<td>0.071</td>
</tr>
</tbody>
</table>
The calculation for the equation of a line is the same as in dissolution.
y=0.0546x+0.0067

Calculations

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>Absorbance (nm)</th>
<th>Amount of drug (micrograms)</th>
<th>Amount of drugs (milligrams)</th>
<th>Amount in 5ml (0.005x)</th>
<th>CR</th>
<th>%CR</th>
</tr>
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<tbody>
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Result:-
The nanosponge gel showed a release of 17.86% of the drug (caffeine) at the end of 6 hrs.

2) Spreadability Test:-
A small amount of gel is put between two slides and a small amount of force is used to check for the spreadability of the gel.

Result:- The gel is easily spread on the surface of the skin.

3) Color:-
The gel is evaluated in front of a black screen to check the color.
The nanosponge gel was found to be clear and transparent.

4) Odor:-
Nanosponges gel formulated is odorless in nature.

5) Texture:-
The texture of the nanosponge gel was found to be smooth.

6) Consistency:-
The nanosponge gel is semi-solid in nature.
CONCLUSION

- The medication of interest, Caffeine was viewed as exceptionally solvent in ethanol.
- The above drug is alluded to as lipophilic however more precisely portrayed as amphiphilic with a parcel coefficient of 4.6. Subsequently, ethanol was utilized as a dissolvable for spectroscopic examinations.
- For the age of nanosponges, a characteristic polymer was utilized while a definition of gel-engineered polymer was utilized which has shown to be viable with the medication of interest.
- Different of these nanosponges proportions were ready and assessed
- Ethyl Cellulose polymer was attractively blended in different states of which 1:1 proportion brought about a lot of wipes with given boundaries.
- The goal behind picking nanosponges gel with caffeine is to give patients a modest however powerful option over the regular treatment.
- The nanosponges arranged to utilize carbopil 940 as the polymer was viewed as the best among all.

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