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FORMULATION AND DEVELOPMENT OF HYDROGEL CONTAINING TRIAMCINOLONE ACETONIDE LOADED NANOSPONGES

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Keywords:

Nanosponges, Triamcinolone Acetonide, Topical drug delivery, hydrogel, Psoriasis

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ABSTRACT: The ideal of the exploration is to formulate hydrogel containing nanosponges of Triamcinolone acetonide for the treatment of Psoriasis. Psoriasis is presently treated with a numerous of topical and systemic remedies. Numerous of these treatments, still, are costly and involve adverse effects, similar as immunosuppression. As a result, there is a need to develop curatives that are effective, have less adverse effects, and are less costly. With the use of solvent emulsion diffusion process triamcinolone acetonide nanosponges were formulated, in which Eudragit L-100 was used as polymer, polyvinyl alcohol was used as an emulsifying agent, and an organic solvent mixture of Dichloromethane was used to make nanosponges. For the preparation of optimized batches of Hydrogel containing nanosponges various gelling agents were used such as Carbopol 934, HPMC K4, Sodium alginate and Acacia with same concentration. Therefore, with the help of different analytical tests *i.e.*, SEM, FT-IR, Zeta potential *etc*. It was confirmed that by using the nanosponges formulation the biopharmaceutical characteristics of triamcinolone acetonide increased which is a BCS Class IV drug.

INTRODUCTION: Advances in pharmaceutical technology have led pharmaceutical scientists to seek optional routes other than oral/ parenteral administration to deliver medicines efficiently and effectively to their target spots. Transdermal treatments are self- reliant, separate dosage forms that release medicines via the skin when applied to undamaged skin. Because of its unsophistication and affordability, topical application is the primary system for delivering therapeutic substances locally.

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When the medicament is applied to the topical surface, it avoids standard hepatic first- pass metabolism, gastric pH and plasma level changes that come about when the medicine is been administered orally [1, 2]. The skin is an important point of general and systemic drug delivery. It's fluently accessible, but has the special ability of being more or less impermeable.

This means that an extensive variety of products can be applied to the skin and removed again if required. Nanotechnology has eventually found out optional ways of targeting drug at the accurate sight and at the right time with least side- effects. Nanosponges are one similar alternative. Nanosponges are kinds of nanoparticles in which drugs are coated within the core formed up of polymer and they spread throughout the body to reach the point of action and releases the

medicament in a predictable form [3, 4]. Anti-diabetic hypoglycaemia drugs, similar as glucagon like peptide- 1(GLP- 1) receptor agonists, di- peptidyl peptidase- 4(DPP- 4) inhibitors, thiazolidinedione's and biguanides, have shown its application in the treatment of psoriasis. In extension, none of the hypoglycaemic drugs show to subdue the immune system. Off- label application of hypoglycaemic drugs to treat severe psoriasis and improve standard of life while escaping the dangerous adverse effects of other systemic drugs may be demanded for patients in whom immunosuppression is contraindicated. Hypoglycaemic drugs can help with psoriasis treatment, especially if you have diabetes or if immunosuppression is not a choice. Non-immunosuppressive remedies that effectively acts on both psoriasis and diabetes would be appealing additions to the treatment scale of dermatologists and endocrinologists' likewise [5, 6].

Thus the ambition of the research was to combine nanotechnology with transdermal delivery system in order to amplify the systemic delivery of the drug Triamcinolone Acetonide, which would effectively transmit the drug into the skin and help treat psoriasis.

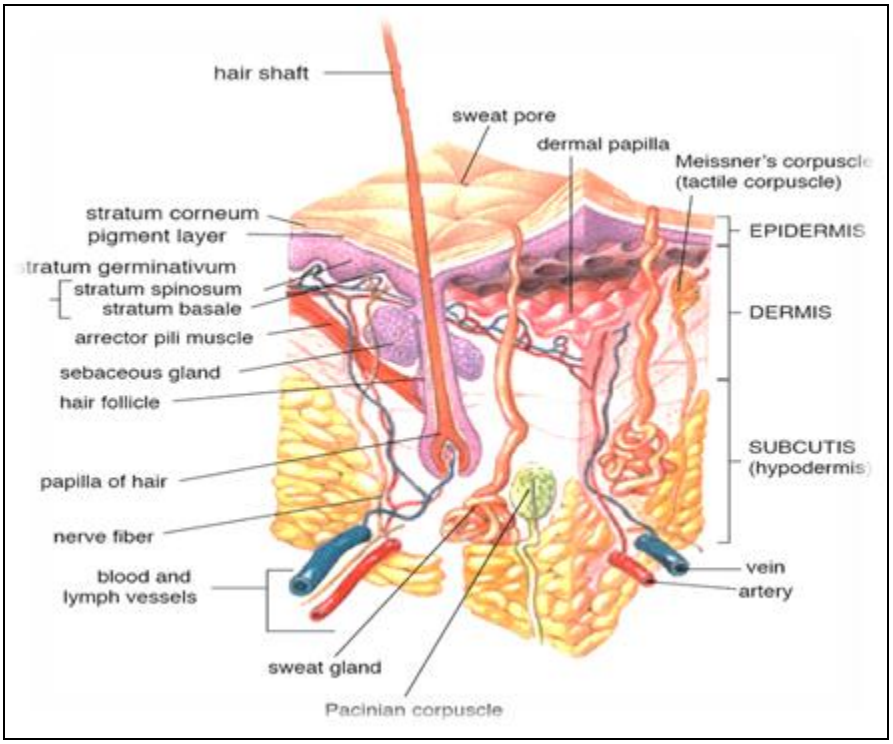

FIG. 1: ANATOMY & PHYSIOLOGY OF THE SKIN

MATERIALS AND METHODS:

Materials: Glenmark Ltd Pharmaceuticals, Sinnar, Malegaon, Nashik provided a free sample of Triamcinolone Acetonide. HPMC K4, HPMC K15, Ethyl Cellulose, Eudragit L100, Ethanol, DMSO, Carbopol 934, Methyl Paraben, Propyl Paraben and Polyvinyl Alcohol, were purchased from Modern science, Nashik. Acacia and Sodium Alginate were obtained as gift sample. Dichloromethane was purchased from Bangalore Fine Chem, Bangalore. All the reagents and solvents used for the study were of Pharmacopoeial and Analytical grade.

Equipment used: Single Pan Electronic Balance (Contech CA224, Japan), Centrifuge (Remi, R-24), Ultrasonicator (Selecdtc 5033, Japan), Melting Point Apparatus (Kumar VMP-D, India), UV-Visible Double Beam Spectroscopy (Shimadzu 2450 Japan), Brookfield Viscometer (Brookfield LDV II+Pro), Magnetic Stirrer (Remi equipment's Pvt. Ltd), FT-IR Spectroscopy (Shimadzu, 8400S, Japan), Differential Scanning Calorimetry (Shimadzu, DSC-60), Scanning Electronic Microscopy (Carl Zeiss, Germany, Supra 5), Digital pH meter (TOSHCON Industries, pH meter CL 54+).

Preformulation Studies: Preformulation is the original step in developing or formulating suitable drug dosage forms. Preformulation studies are

carried out for dosage forms in order to optimise drug delivery by determining the physicochemical features of the new molecule that may affect the development or performance of dosage forms in terms of stability, safety and efficacy. Preformulation studies gives all of the data needed to identify the nature of the drug substance [7].

Melting Point: Melting point was attained by utilising the capillary tube method. A little quantity of drug was fitted in a tube (capillary tube) with one end closed and placed in a melting point apparatus, with the temperature at which the drug melted being recorded. The average of three readings was calculated. The observed and reported values were compared. Kumar VMP- D is the apparatus employed for determining melting point [7].

Solubility Study: Triamcinolone Acetonide solubility in water, ethanol, and Dichloromethane (DCM) was delved using the shake flask method. In 1- 10 mL of the applicable detergent, the researched chemical was dissolved in solid excess. The solutions were swirled in a magnetic stirrer for 48 hours under thermostatic conditions until they reached solubility equilibrium. The solutions were left to settlings under thermostat conditions to separate the phases. Filtration was carried out on the solution. Aliquots of the solution were collected from the clear section. After diluting the aliquots, the absorption was taken using a UV-Spectrophotometer (Shimadzu UV- 2600). The aliquots' concentrations were calculated [8].

Ultraviolet-Visible Spectroscopy: The wavelength (maximum) at which Triamcinolone Acetonide shows maximum absorbance was determined using UV spectroscopic analysis (Shimadzu; UV 2600). To make a 1000ppm stock solution, the drug was precisely counted and dissolved in solvent water, ethanol and phosphate buffer (7.4 pH). This solution was further diluted using the same solvent to achieve a concentration of 100ppm. The UV ranges of this concentration was also recorded at wavelengths ranging from 200 to 400 nm. The UV spectrum of the drug was also measured in ethanol and phosphate buffer (7.4 pH).

Preparation of Calibration Curve: A series of dilutions with concentration 2, 4, 6, 8, 10 ppm were prepared from Triamcinolone Acetonide 100 ppm stock solution in phosphate buffer (pH7.4) and were examined at the determined absorption maximum. Absorbancevs. Concentration graph was put up [9].

Fourier Transforms Infrared Spectroscopic (FTIR) Study: A FT- IR Spectrophotometer was used to note the drug's FT- IR spectrum (Shimadzu 8400S). In themid-IR 4000- 400 cm^{-1} spectral range, the diffuse reflectance approach was used. The method entails dispersing the sample in KBr (100 mg) with a mortar, triturating the accoutrements into a fine powder bed, and loading the accoutrements into the holder with a compression gauge. For 5 minutes, the pressure was roughly 5 tonnes.

The spectrum was noted when the pellet was placed in the light path. The functional groups' characteristic peaks were clarified. Triamcinolone Acetonide and the polymer ethyl cellulose had their FTIR spectra recorded. To assure that Triamcinolone Acetonide and polymer were compatible, the spectrum of their physical combination was recorded [7-9].

Differential Scanning Calorimetry (DSC) Study: The DSC analysis of a Triamcinolone Acetonide drug sample was carried out using a DSC instrument (Shimadzu, DSC 60). A small quantity of Triamcinolone Acetonide (2 to 3 mg) was precisely balanced in an aluminium pan, hermetically sealed with the help of a crimper, and stored in the DSC analyser. The sample was heated at a rate of 100 degrees Celsius per minute from 400 °C to 4000 °C. Purging nitrogen gas at a rate of 100 ml/ min was used to produce inert atmospheres.[9]

Formulation of Triamcinolone Acetonide Loaded Nanosponges: Triamcinolone Acetonide loaded nanosponges were formulated by Solvent Emulsion Diffusion Technique. The polymer was chosen based on the results of experimental batches employing several polymers such as Ethyl Cellulose, HPMC K4, HPMC K15 and Eudragit L100 with the drug in 1:2 ratios. The results indicated that Ethyl Cellulose and Eudragit L100 were suitable for the formulation of nanosponges loaded with Triamcinolone Acetonide.

Hence, batches were formulated using Eudragit L100 as polymer with Drug: Polymer ratio varying from 1:2 to 1:12. The Organic phase (Dispersed phase) was prepared by dissolving 25mg of drug Triamcinolone Acetonide & specified amount of polymer in 20ml of organic solvent which is a mixture of Dichloromethane. The Aqueous phase (Continuous phase) was prepared by dissolving definite amount of polyvinyl alcohol (PVA) in 100ml of Distilled water. The Dispersed phase was dropwise added into the aqueous phase by stirring on magnetic stirrer and then homogenized for 1 hour at 1000rpm. The nanosponges formed were collected by filtration and dried in hot air oven at 40ºC for 24 hours. They were then kept in vacuum desiccator to remove the residual solvent. The composition of Triamcinolone Acetonide loaded nanosponges is given in **Table 1.**

TABLE 1: COMPOSITION OF TRIAMCINOLONE ACETONIDE LOADED NANOSPONGES

Formulation Code	Organic phase			Aqueous phase	
	Drug(mg)	Polymer (mg) Eudragit L100	DCM (ml)	PVA (mg)	Distilled water (ml)
F1	25	50	20	500	100
F2	25	100	20	500	100
F3	25	150	20	500	100
F4	25	200	20	500	100
F5	25	250	20	500	100
F6	25	300	20	500	100

Characterization of Optimized Nanosponges: Various evaluation tests were performed on the formulated batches of nanosponges, including percentage yield, entrapment efficiency, actual drug content, and in-vitro drug release. The best suitable formed batch was considered the optimised batch for further evaluation based on the test findings obtained from all of the batches.

Determination of Percentage Yield: Formulated nanosponges were weighed after drying. Percentage yield was calculated by,

Production yield = Practical weight of Nanosponges / Theoretical weight (Drug + Polymer) × 100

Drug Entrapment Efficiency: Appropriate quantity of Triamcinolone Acetonide loaded nanosponges were crushed using a mortar pestle. 10mg of nanosponges were suspended in 10ml Ethanol. After 24 hours' solution was filtered and then the filtrate was appropriately diluted with phosphate buffer and analysed using UV Vis Spectrophotometer. The Drug Entrapment Efficiency was calculated using the following formula –

Drug Entrapment Efficiency = Experimental drug loading / Theoretical drug loading × 100

Infrared Spectroscopy: Triamcinolone Acetonide loaded nanosponges formulation's FTIR spectra was recorded. A few milligram of Triamcinolone Acetonide nanosponges (F3) were weighed and combined with 100 milligram of potassium bromide (dried at 40°-50°C). The combination was then compacted into a pellet using a hydraulic press with a 10-ton pressure. The pellet was then scanned with an IR Spectrophotometer in the wavelength region of 4000-400 cm^{-1}.

Particle Size Analysis: At 25°C, the Dynamic Light Scattering technique is used to determine the average mean diameter and size distribution of loaded nanosponges. To produce the required light scattering intensity for the optimized batch of Triamcinolone Acetonide nanosponges, the dried nanosponges were dispersed in water.

Determination of Zeta Potential: Surface charge is measured by the zeta potential. Using a Zeta sizer with zeta cells, a polycarbonate cell with gold plated electrodes and water as the sample preparation medium, the surface charge (electrophoretic mobility) of nanosponges can be evaluated. It is necessary for determining the stability of the optimized batch of nanosponges.

Scanning Electron Microscopy (SEM): The microscopic characteristics (shape and morphology) of the optimized batch of Triamcinolone Acetonide nanosponges were determined by SEM examination. SEM photos were acquired at various magnifications using nanosponges that had been produced and dried thoroughly to reduce moisture content. Samples were placed on glass slides kept under vacuum and then coated with a thin gold coating using a sputter

coater device operating at 15kv acceleration voltage.

Formulation of Triamcinolone Acetonide Nanosponges loaded Hydrogel: Nanosponges equivalent to 5% of Triamcinolone Acetonide was dissolved in distilled water in a beaker. 1 gram of gelling ingredient was soaked in sufficient distilled water to swell overnight. The gelling agents employed included Carbopol 940, Acacia, HPMC, and Sodium Alginate. Using a magnetic stirrer, continuously swirl the remaining excipients with the previously soaked gelling agent for 1-2 hours.

To adjust the pH, Triethanolamine was employed. The gel was placed in a graduated cylinder and filled to a capacity of 20ml with distilled water. The formula for preparation of the hydrogels is given in **Table 2.**

TABLE 2: COMPOSITION OF TRIAMCINOLONE ACETONIDE NANOSPONGES HYDROGEL CONTAINING DIFFERENT POLYMERS

Ingredients	F1	F2	F3	F4
Drug loaded Nanosponges (mg)	50	50	50	50
Carbopol 940 (gm.)	1	-	-	-
HPMC K4 (gm.)	-	1	-	-
Sodium Alginate (gm.)	-	-	1	-
Acacia (gm.)	-	-	-	1
Methyl Paraben (gm.)	0.1	0.1	0.1	0.1
Propyl Paraben (gm.)	0.05	0.05	0.05	0.05
DMSO (ml)	10	10	10	10
Water (ml) q.s.	20	20	20	20

Characterization of Triamcinolone Acetonide Nanosponges Loaded Hydrogel: Viscosity, pH, drug content, *in-vitro* dissolution test, and spreadability are all factors to consider while evaluating a gel.

Physical Evaluation: The gel was analysed for its homogeneity and clarity.

Drug Content: To ascertain the drug's true content, 1 gram of gel containing 5% medication was suspended in 100 ml of phosphate buffer (pH 7.4). Thereafter, 1ml of the solution was diluted to 10 ml. Using UV Vis Spectroscopy, the concentration of Triamcinolone Acetonide in the prepared gel was evaluated by measuring the absorbance of all samples at 239nm. The pure drug concentration was determined using the slope and intercept obtained from the linearity equation,

$$Y = mx + C.$$

pH: A digital pH metre was used to determine the pH of the formulation. Set the pH of the water to 7 before measuring the pH of the formulated gel.

Viscosity: The viscosity of the produced gel was measured using a Brookfield viscometer spindle LV6 at various rpm and recorded.

Spreadability Test: The spreadability of the gel formulation was assessed by measuring the diameter of 1gm of gel between horizontal plates after 1 minute using a sliding plate equipment. The upper plate's specified weight was 125 grams. To compress the sample to a uniform thickness, an excess of gel is placed between two glass slides and a 500gm weight is placed on them for 5 minutes. Weights are placed in the pan and the bottom slide is attached to the apparatus. Spreadability is measured by the time it takes to separate the two slides in seconds. Spreadability is better when the time interval is shorter.

$$S = M \times L / T$$

RESULTS AND DISCUSSION:

Evaluation of Triamcinolone Acetonide Loaded Nanosponges:

Physical Characteristics: Triamcinolone Acetonide was checked for its colour, odour and texture. The Triamcinolone Acetonide powder was found to be white, odourless, crystalline and hygroscopic in nature. The melting point was observed to be in the range 285°C - 293°C, the outcome is identical to that stated in the reference.

In distilled water, the medication was found to be practically insoluble, slightly soluble in ethanol and methanol and freely soluble in DCM. Hence, dichloromethane as the organic solvent for the preparation of internal phase in the formulation of nanosponges.

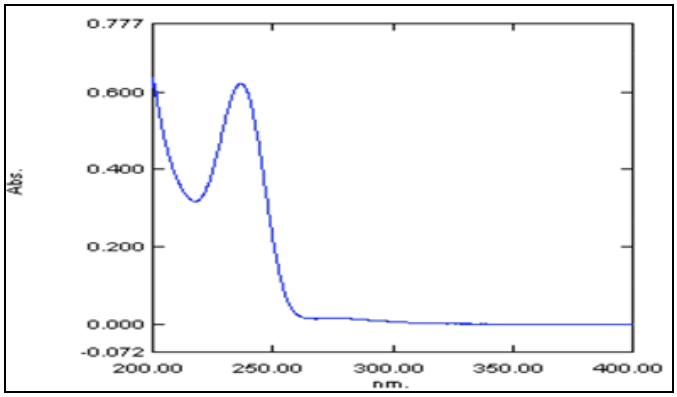

FIG. 2: UV- VIS SPECTRUM OF TRIAMCINOLONE ACETONIDE IN ETHANOL

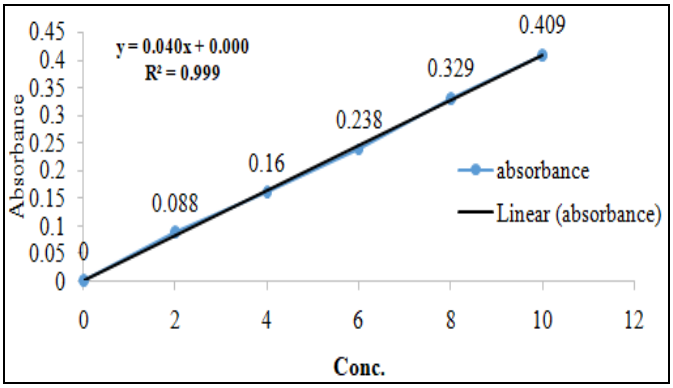

FIG. 3: CALIBRATION CURVE OF TRIAMCINOLONE ACETONIDE IN ETHANOL

Absorption maxima (λmax) of Triamcinolone Acetonide in Ethanol: The λmax of Triamcinolone Acetonide in Ethanol was observed to be 239nm which is as per the pharmacopoeial standard *i.e.,* 239 nm.

The absorbance for the dilutions of Triamcinolone Acetonide for 2,4,6,8 and 10ppm were recorded at the λmax. Absorbance *vs*. Concentration graph was plotted and linearity was obtained with an R2 = 0.9991 as shown in the **Fig. 3.** The Solvent Emulsion Diffusion method was found to be simple and suitable for the laboratory scale preparation of Triamcinolone Acetonide nanosponges. Based on the entrapment efficiency of the drug Eudragit L100 was selected as the polymer for the formulation of the nanosponges.

The λmax was found to be 239nm Concentration(µg/ml)	Absorbance
0	0
2	0.088
4	0.160
6	0.238
8	0.329
10	0.409

Production yield percent is represented in the **Table 3.** The practical yield for all the formulated batches was observed in the range 37% to70.91%. The F6 batch gave the highest practical yield (70.91%) whereas F1 batch gave the lowest practical yield (37%). It was observed that with the increase in the polymer concentration there was an increase in the practical yield i.e. F6> F5> F4> F3> F2> F1.

TABLE 3: PRODUCTION YIELD, ENTRAPMENT EFFICIENCY, PARTICLE SIZE AND ZETA POTENTIAL OF TRIAMCINOLONE ACETONIDENANOSPONGES (F1 TO F6)

Formulation code	Practical yield	Entrapment Efficiency (%)	Particle Size	Zeta Potential
F1	37.00%	91.00±0.066	200.21 ±3.13	-23.33
F2	45.71%	78.00± 0.148	259.77± 21.01	-25.89
F3	55.36%	86.60 ±0.085	230.89± 35.51	-29.35
F4	60.80%	60.08 ±0.03	290.01± 6.89	-32.87
F5	65.85%	62.85± 0.059	318.33 ± 8.32	-35.77
F6	70.91%	70.91± 0.063	305.69± 5.02	-37.09

Entrapment Efficiency for the Triamcinolone Acetonide loaded nanosponges batches F1 to F6 was determined using UV visible spectroscopy. Batch F1 showed the most entrapment efficiency of roughly 91%, whereas batch F4 showed the least entrapment efficiency of roughly 60.08%. The entrapment efficiency of all the batches was set up to be in a descending order as F1> F3> F2> F6> F5> F4 is illustrated in the **Table 3** and **Fig. 4.** Particle size analysis is one of the most critical characteristic property of nanosponges and thus was performed for all the 6 batches. All of the batches' mean particle size was found to be in the nanoscale range, as displayed in the **Table 3** with batch F1 with the smallest mean particle size of roughly 200.21 nmas exemplified in the **Fig. 5.** The mean particle size of all the batches was found to be indescending order as F5> F6> F4> F2> F3> F1. The particle size of nanosponges should be less than 1µ. All of the batches had a mean particle size of lower than 1µ, ensuring that nanosponges were formed. Zeta potential study was carried out for all the batches in order to determine the colloidal property and the stability of the formulated batches.

Nanoparticles with zeta potential lesser than 25 mV or lower than - 25 mV generally have loftiest stability. The observances are illustrated in the **Table 3**. The best formulation was batch F1 on the base of zeta potential analysis. For Triamcinolone Acetonide nanosponges with Eudragit L100 (F1) the zeta potential was found to be -23.33 mV with peak area of 100 intensities. These value indicate that the formulated F1 batch is stable. The zeta potential report of batch F1 is demonstrated in **Fig. 6.** IR spectrum for the pure drug Triamcinolone Acetonide, physical combination of drug and polymer and for the optimized batch F1 was taken and all the characteristic peaks were observed as depicted in the **Fig. 7** and **8** independently. The peaks present in the FT- IR of pure Triamcinolone Acetonide are present in the physical blend containing the drug with polymer Eudragit L100.

It is thus apparent that Triamcinolone Acetonide is compatible with Eudragit L100 and can thus be chosen as the polymer for the formulation of nanosponges.

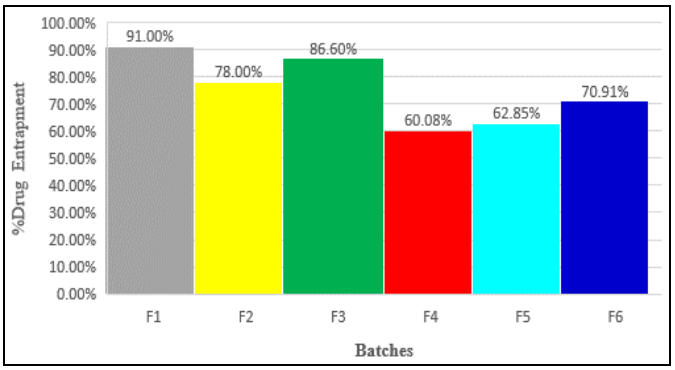

FIG. 4: ENTRAPMENT EFFICIENCY OF TRIAMCINOLONE ACETONIDELOADED NANO-SPONGES (F1 TO F6)

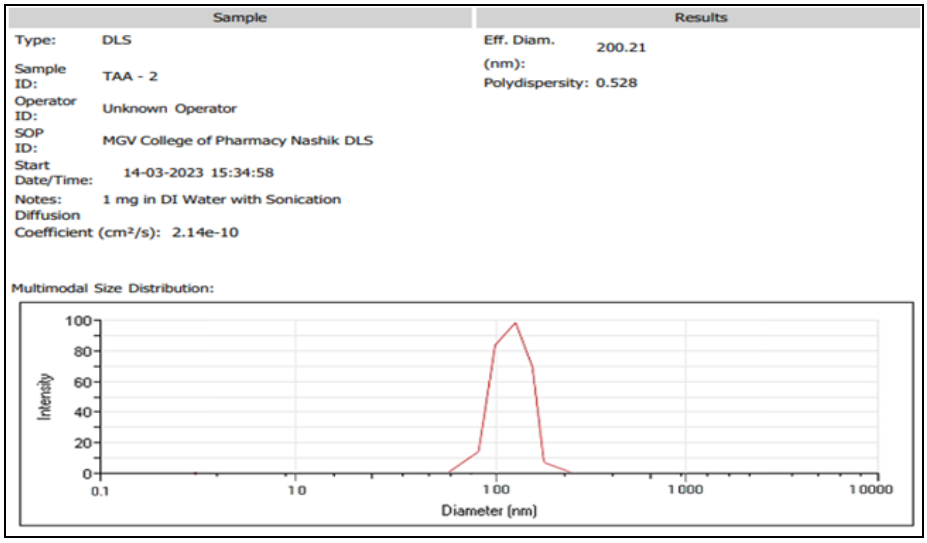

FIG. 5: PARTICLE SIZE REPORT OF BATCH F1

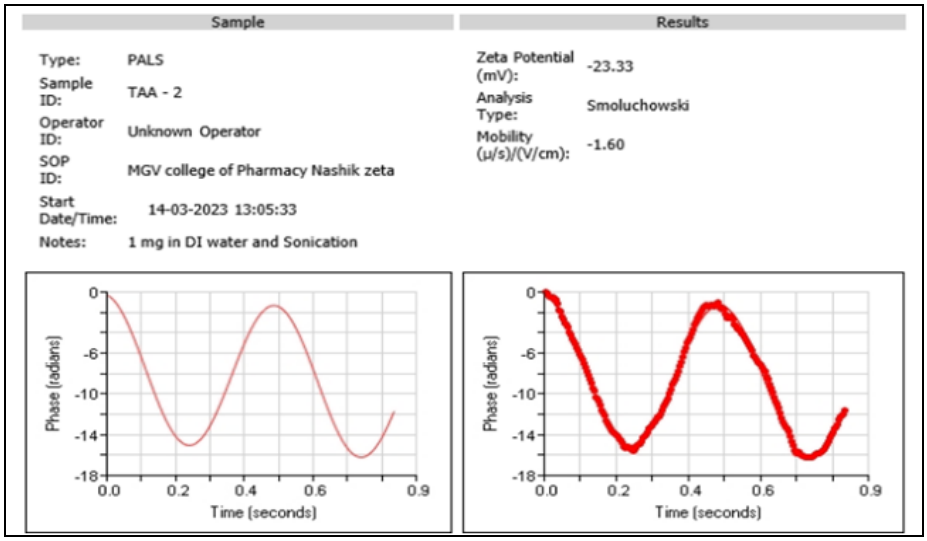

FIG. 6: ZETA POTENTIAL REPORT FOR BATCH 1

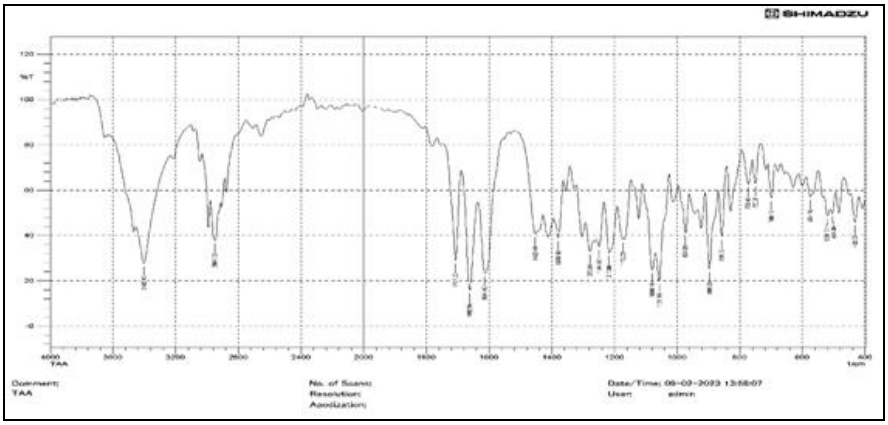

FIG. 7: IR SPECTRUM OF TRIAMCINOLONE ACETONIDE (DRUG)

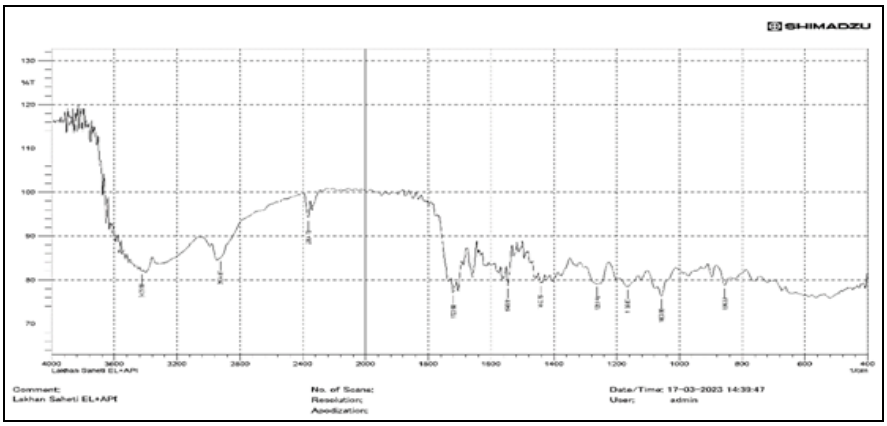

FIG. 8: IR SPECTRUM OF TRIAMCINOLONE ACETONIDE AND ETHYL CELLULOSE (DRUG + POLYMER)

Surface Morphology: SEM analysis of the formulated Triamcinolone Acetonide nanosponges (Batch 1) was performed to evaluate the surface morphology of the nanosponges. Particle size and morphology of nanosponges were also studied by scanning electron microscopy SEM). The SEM images of the optimized F1 batch showed the typical morphological aspects of nanosponges. SEM analysis reports confirmed that the nanosponges are segregated, spherical in shape with smooth surface and are porous in nature with particle size less than 1µ. The SEM images of Triamcinolone Acetonide nanosponges Batch 1 is shown in the **Fig. 9.**

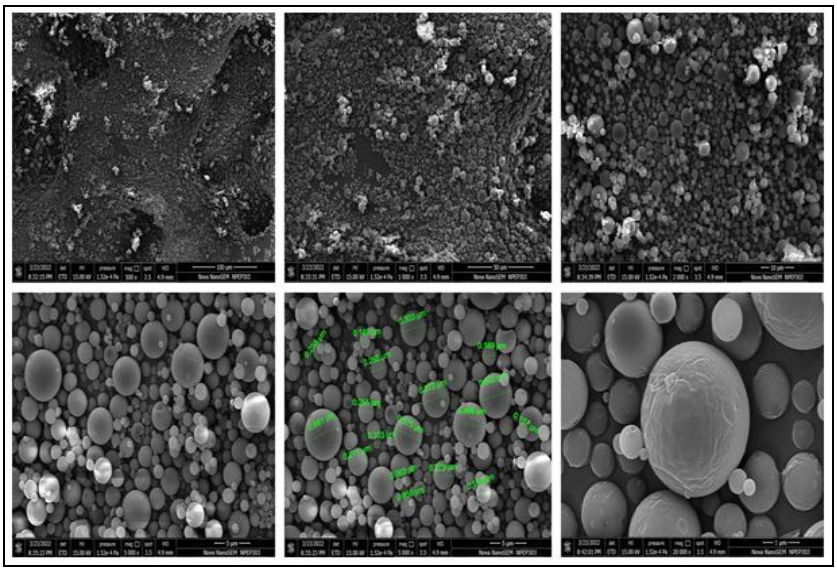

FIG. 9: SEM ANALYSIS REPORT OF TRIAMCINOLONE ACETONIDE NANOSPONGES (BATCH 1 OF EUDRAGIT L-100)

Evaluation of Triamcinolone Acetonide Nanosponges Hydrogel:

Physical Characteristics: The physical characteristics of the formulated batches of Hydrogel (F1 to F4) *i.e.* clarity, homogeneity, pH, spreadability and viscosity was observed. The pH of the Hydrogels was determined using Digital pH meter. The pH of the hydrogels was found to be in the range of 5 to 6. The normal pH of the skin lies in the range 4.5 to 5.5. Extremes of pH on acidic or basic side can always cause irritation to the skin or redness. Hence, the pH determined for the Hydrogel formulations was found to be suitable for application on the skin. The results obtained for pH, Spreadability, Homogeneity and Actual Drug Content % of formulations is given in **Table 4.**

TABLE 4: PH, SPREADABILITY, HOMOGENEITY AND ACTUAL DRUG CONTENT % OF FORMULATIONS (F1 TO F4)

Hydrogel code	pH	Actual Drug Content	Spreadability	Homogeneity
H1	5.58	78.85	41.67	Good
H2	5.60	72.01	62.5	Good
H3	5.35	78.61	53.57	Good
H4	5.40	72.43	83.33	Good

Viscosity: The viscosity of all the formulated batches of Hydrogel consisting of four different types of gelling agents – Carbopol 934, HPMC K4, Sodium Alginate and Acacia was measured using the Brookfield Viscometer at varying rpm. The viscosity of the batches was found to be in an increasing order as F1>F3>F2>F4. The viscosity of batch F1 consisting of Carbopol 934 was found to have the highest viscosity, whereas batch F4 consisting of Acacia was found to have the lowest viscosity. The viscosity of all the formulated Hydrogels is illustrated in the **Table 5**. Gelling agent (F2) shows the lowest drug release as compared to other Hydrogels.

TABLE 5: VISCOSITY STUDY OF FORMULATIONS (F1 TO F4)

Formulation batch	RMP	Viscosity
H1	10, 25, 50, 70, 100	17037, 9358, 7678, 5783, 4451
H2	10, 25, 50, 70, 100	9856, 7246, 6538, 4692, 2355
H3	10, 25, 50, 70, 100	15637, 8932, 7653, 5214, 4039
H4	10, 25, 50, 70, 100	7358, 5783, 3467, 3016, 2124

***In-vitro* Diffusion Study:** The diffusion rate studies were performed to evaluate the diffusion characteristics of Triamcinolone Acetonide from the prepared nanosponges Hydrogel. The percentage drug release for all the hydrogels was found to be in the range 62.13% to 80.66% within given time period. From the results obtained the hydrogel containing Carbopol 940 as the gelling agent (H1) shows the highest drug release in comparison to the other 3 batches. Whereas, hydrogel containing HPMC K4 as the gelling agent (H2) shows the lowest drug release as compared to other Hydrogels. The results of the drug diffusion study are shown in the **Table 6** and **Fig. 10.**

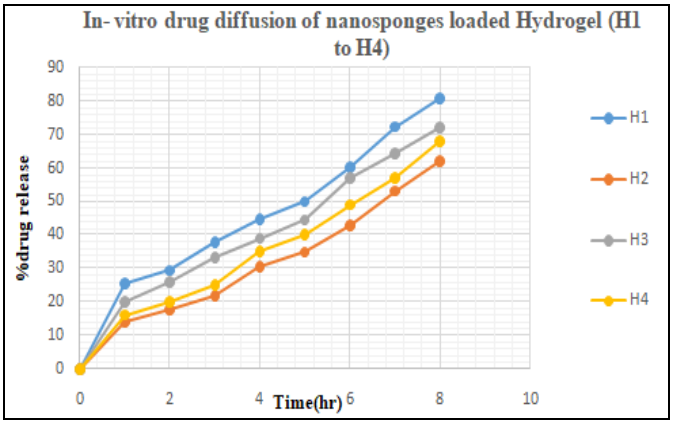

FIG. 10: % DRUG RELEASE OF NANOSPONGES LOADED HYDROGELS

TABLE 6: % DRUG RELEASE STUDY OF HYDROGEL FORMULATIONS (F1 TO F4)

Time (Hrs.)	Formulation Code			
	H1	H2	H3	H4
0	0	0	0	0
1	25.68	14.11	20.09	16.17
2	29.45	17.82	26.08	20.26
3	37.95	22.03	33.19	24.96
4	44.51	30.69	39.01	35.01

5	49.93	34.99	44.55	40.22
6	60.08	42.81	57.14	49.03
7	72.21	53.18	64.38	56.96
8	80.66	62.13	72.16	67.99

From the results obtained for the *in-vitro* diffusion study of all the formulated batches of Hydrogel the Hydrogel formulated using Carbopol 940 and Sodium Alginate show satisfactory results and therefore can be suggested for further extensive research.

CONCLUSION: In the present study, Triamcinolone Acetonide has been successfully incorporated in nanosponges. From the observations and the test results obtained it can be speculated that all the formulations showed satisfied properties. The Triamcinolone Acetonide loaded nanosponges were formulated by Solvent emulsion diffusion method and were then examined for various parameters like Physical properties, Production yield, Entrapment efficiency, Particle size, Zeta potential for nanosponges. The study confirmed that batch F1 showed the highest entrapment efficiency with the lowest particle size and hence was considered as the optimized batch. Hence F1 batch was further subjected for Surface morphology study. The entrapment efficiency and the average particle size for the optimized batch (F1) was found to be 91.00% and 200.21nm respectively. Triamcinolone Acetonide loaded nanosponges gel was prepared and evaluated for viscosity, pH and in-vivo drug diffusion study. Triamcinolone Acetonide can be formulated into low dose nanosponges loaded hydrogel for the treatment of psoriasis with concomitant diabetes. This study therefore recommended for further extensive research.

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