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Extraction, characterisation and evaluation of curcumin gel

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Abstract

This paper describes the formulation and evaluation of transdermal gels for topical delivery of Curcumin. A polymer with well-defined transdermal characteristics, such as Carbopol 934, was used in this investigation. Using a variety of absorption enhancers, including Mannitol, sodium lauryl sulfate, and polyethylene glycol, carbopol, HPMC gels containing 1% curcumin were prepared using a cold technique. Due to its poor bioavailability, Curcumin has been produced in a gel form with sodium lauryl sulfate, mannitol, and polyethylene glycol as absorption enhancers. The gels underwent investigation concerning gelation temperature, pH, viscosity, drug release profile, drug content, stability studies, and kinetic analysis of drug release data. Because sodium lauryl sulfate shows a higher percentage of drug release than other absorption enhancers, it was determined to be a better enhancer of absorption.

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INTRODUCTION

In recent times, the administration of drugs to the human body through various routes, such as oral, sublingual, rectal, parental, topical, inhalation, etc., has been the method used to treat illnesses. Applying a topically drug-containing formulation to treat cutaneous conditions like acne or the cutaneous signs of a general disease like psoriasis to limit the drug's pharmacological or other effects on the skin's surface or inside the skin is known as topical delivery [1]. Though foams, sprays, medicated powders, solutions, and even medicated adhesive systems are in use, semi-solid formulations, in all their diversity, dominate the system for topical delivery. One of the most complex products to produce is a topical

formulation that delivers a drug to a specific spot. An efficient topical formulation must offer a stable chemical environment in an appropriate dispensing container for numerous chemicals with potentially disparate if not incompatible, physicochemical properties to coexist. After application, a topical formulation must interact with the skin's environment to determine how quickly the compounds release and attain proper skin absorption [2]. The excipients can have extra physical effects on the skin, such as moisturizing, occluding, or drying. Knowledge of the physics, chemistry, pharmacodynamics, and pharmacokinetics of drugs used to treat acne has improved using research and technology. These realizations have led to the development novel delivery technologies that can improve topical formulations' cosmetic acceptability, tolerability, and efficacy [3].

MATERIALS AND METHODS

MATERIALS:

Curcumin was obtained as a gift sample from Krish Enterprises Private Limited, Mumbai. All the other chemicals like HPMC, carbopol, sodium lauryl sulfate, polyethylene glycol, and propylene glycol were obtained from SDFCL, S.D. fine- chemicals limited, Mumbai.

APPARATUS:

Magnetic Stirrer (Aarson Scientific Works). Sonicator (PCI Analytics. Digital pli meter (Aarson Scientific works). U V Visible Spectrophotometer (Analytical Technologies Ltd) Electronic balance (WENSAR), Modified Franz Diffusion cell, FTIR (BRUKER)

METHODS:

PREFORMULATION STUDIES:

An essential requirement for developing any drug delivery system is preformulation research. These comprised solubility and compatibility recommendations, which were carried out on the drugs [4].

Interaction Studies:

Drug-polymer interaction study:

With the use of FTIR spectroscopy, drug-excipient interactions were identified. Different excipients were combined individually in a 20:80 ratio with curcumin powder. The physical mixture produced was stored in glass containers with a lid for three weeks at various temperatures [5]. Two assessment criteria investigated the relationship between the medication and excipients. Ion excipient combinations under various conditions [**Figure 1**].

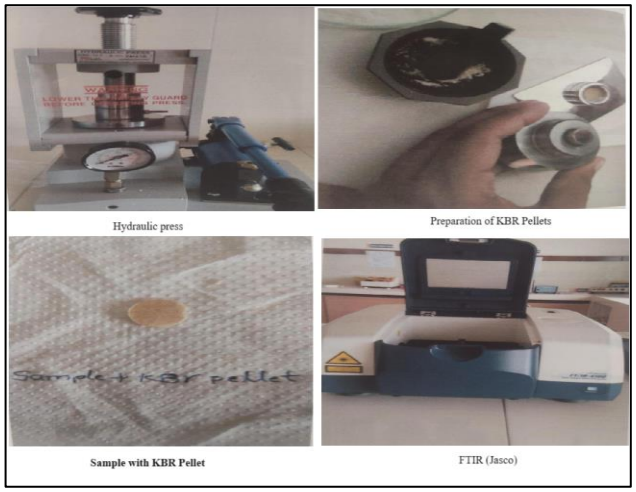

Figure 1 Images of Instrumentations

METHODOLOGY

Preparation of Curcumin Gel

A weighed quantity of Curcumin in all the formulations Carbopol, HPMC, P.G., and PEG was taken and added to the distilled water. Curcumin was solubilized in an appropriate amount of ethanol, and this ethanol dispersion of Curcumin was transferred to polymers with an aqueous dispersion [6]. The mixture was stirred gradually with a stirrer, and the polymers were allowed to soak for 2 hours. The SLS and Mannitol were added to neutralize the polymer solution and to form the gel [**Table 1** & **Figure 2**]. The pH was adjusted to 6.8.

Figure 2 Formulations of F1, F2, F3, F4

Table 1 Formulation of Curcumin gels

Formulations	F1	F2	F3	F4
Carbopol (%)	-	2	-	2
HPMC (%)	-	-	2	2
Curcumin (%)	2	2	2	2
Propylene glycol (ml)	5	5	5	5
PEG (ml)	5	5	5	5
Mannitol (ml)	5	5	5	5
SLS (ml)	5	5	5	5

EVALUATATION STUDY OF CURCUMIN GEL

P.H.: Take 1g of formulation into three separate beakers. Add 100 ml of distilled water to the three samples and mix thoroughly until it dissolves. Now rinse the electrode tip in deionized water from the pH meter and depress the dispenser button on the top of the electrode until a click is heard. Calibrate the pH meter before performing pH on other standard buffer solutions. Note the values of three samples; accordingly, record the average value of the three values [7]. The same procedure is repeated for the following formulations, and their values should be recorded accordingly. Take the formulations F1, F2, F3, and F4 respectively

SPREADABILITY:

The formulation takes 0.5 g of gel onto the glass slide 1. Place another slide, slide two, on top of the previous glass slide with the gel sample. Place 250 g weight on slide 2. Measure the distance (cm) after 15 min. This entire procedure should be repeated with the other formulations respectively. Record the distance spread by the formulations. Take the prepared formulations of curcumin gel of F1, F2, F3, and F4 [8].

Drug Content Studies

Take 1 g of gel and dissolve it in 100 ml of phosphate buffer, considered a sample. From the above sample solution, take 1ml, 5ml, 10ml, 15ml, and 20ml of sample into volumetric flasks, respectively. These five samples should be made up of 10 ml of distilled water. Take one by one sample in a curette, which should be kept in a UV-visible spectrophotometer. Set the standard wavelength of Curcumin at about 427nm, measure the absorbance of each sample, and note down the values. This procedure is repeated for the remaining samples, and the values are noted down [9].

VISCOSITY

Put the prepared solution in the Brookfield viscometer, Select a spindle speed based on the sample's expected viscosity, Gently lift the coupling nut on the viscometer with one hand and screw the spindle on with the other Turn the gear knob until the fluid is level with the spindle's immersion groove. Enter the spindle entry code [10]. Scroll to the correct spindle code and press the Select spindle button again to lock in the code and set the speed. Allow the viscometer reading to stabilize, which usually takes 30–45 seconds.

In vitro drug release studies

The membrane diffusion method was used to measure curcumin gels. The 10 mg of gels are placed in a glass tube measuring 2.5 cm in diameter and 8 cm in length. The tube was coated

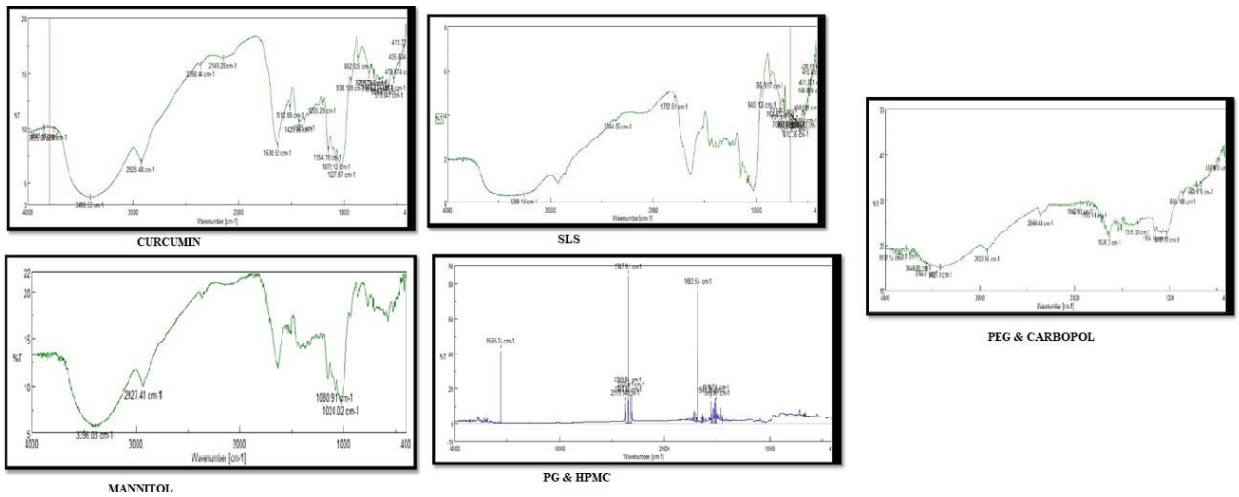

Figure 3 FTIR Spectrum of Drug and Polymers

with a soaking osmosis cellulose membrane as a donor compartment. The glass tube was put into the receptor compartment, and a beaker was filled with 100 ml of saline buffer pH 7.4. Everything was adjusted such that the tube containing the suspension barely touched (1-2 mm deep) the diffusion medium's surface. Finally, the absorbance of the drug is measured [11].

RESULTS AND DISCUSSION

Drug-polymer interaction study

The FTIR data showed that Curcumin and excipients did not react with each other and retained their action at room temperature [**Figure 3**, **Table 2** and **Table 3**].

Table 2 Physical changes in drug excipient mixture

Drug (Excipient)	At room temperature	At 50°C	At 40°C
Curcumin HPM 188	No change is observed.	HPMC 188 Melted	No change
Curcumin Carbopol 934	No change is observed.	No change	Carbopal 934 absorbed moisture.

Table 3 Position of characteristic absorptions at definite wave number in Carbopol

	Wave number (em)	Characteristic absorption's
PEG & Carbopol	2935	Aliphatic carbon
	1706	Carbonyl group
	1216	C-C
	3260	C-H
PG & HPMC	2878	Aldehyde
	1463	CH bending
	3999	O-H
	1098	C-C
Mannitol	3392	O-H
	1012	C-C
	2900	Aliphatic carbon
	1412	CH bending
SLS	1215	S=O stretching
	2849	aldehyde
	2917	C-H stretching
	3470	O-H
Curcumin	3236	O-H
	1623	Carbonyl group
	2917	C-H stretching
	993	C-C

CHARACTERIZATION OF CURCUMIN GEL:

pH

At the end of the 6th hour, the pH of all formulations was found to be 6.65, 6.72, 6.70,6.68 respectively. The results are plotted in Table 5.

Spreadability

The Spreadability was determined, and the F3 formulation was found to have more % of Spreadability when compared with F1 and F2 formulations. Results are tabulated in Table 5.

Viscosity studies

As the rpm increases, the viscosity of all formulations decreases. F2 formulation is found to be less dense when compared to F1 F3 formulations. The viscosity of F1, F2, and F3 formulations are depicted and plotted in **Table 4**.

Table 4 Viscosity studies of curcumin gel

Rpm	Viscosity (cps)		
	F1	F2	F3
20	498	523	230
50	365	486	163
100	327	392	122

Drug content

% drug content was determined, and F3 formulation had more % of drug content when compared with F1 and F2 formulations. Results are tabulated in **Table 5**.

Table 5 pH of curcumin gel

Formulations	pH	Drug Content	Spreadability (cm)
F1	6.65	98.5%	3
F2	6.72	96.7%	3.5
F3	6.70	98.6%	4
F4	6.68	98.7%	4.2

Drug release study

After in-vitro drug release studies, it's clear that the F3 formulation shows better release when compared to the F1 and F2 formulations. In the case of F1 and F2 formulations, the % cumulative drug release was found to be 58.57% and 67.86% by the end of the 6th hour, whereas the F3 formulation showed 97.28% of cumulative percentage of drug release [**Table 6**, **Table 7** and **Table 8**].

Table 6 % Cumulative release of Curcumin with PEG as absorption enhancer

Time (hr)	Absorbance	Concentration (µg/ml)	Amount of drug release (mg)	% Drug release	Cumulative drug release
0.30	0.16	6.34	57.06	11.412	11.47
1	0.38	15.07	135.63	27.126	27.21
2	0.42	16.66	149.94	29.988	30.00
3	0.51	20.23	182.07	36.414	36.44
4	0.55	21.82	196.38	39.276	39.29
5	0.78	30.95	278.55	55.71	55.80
6	0.82	32.53	292.77	58.554	58.554

Table 7 % Cumulative release of Curcumin with Mannitol as absorption enhancer

Time (hr)	Absorbance	Concentration (µg/ml)	Amount of drug release (mg)	% Drug release	Cumulative drug release
0.30	0.21	8.32	74.88	14.976	15.06
1	0.42	16.66	149.9	29.126	30.07
2	0.56	22.21	199.8	39.978	40.03
3	0.65	25.78	232.0	46.404	46.43
4	0.78	31.75	295.3	59.26	59.28
5	0.88	34.91	314.1	62.838	62.88
6	0.95	37.69	339.2	67.842	67.86

Table 8 % Cumulative release of Curcumin with SLS as absorption enhancer

Time (hr)	Absorbance	Concentration (µg/ml)	Amount of drug release (mg)	% Drug release	Cumulative drug release
0.30	0.26	10.31	92.79	18.55	18.64
1	0.49	19.44	174.96	34.99	35.07
2	0.62	24.60	221.4	44.28	44.32
3	0.77	30.55	274.95	54.99	55.04
4	0.83	32.93	296.37	59.27	59.29
5	0.91	41.11	364.9	79.89	80.09
6	0.98	53.96	485.64	97.12	97.28

CONCLUSION:

Curcumin exhibits a more significant number of applications as a therapeutic agent, and it is currently in human clinical trials for various contraindication therapeutic agents, multiple myeloma, pancreatic cancer, myelodysplastic syndromes, colon cancer, and Alzheimer's disease. However, it is having a severe bio-availability problem. The reasons for its reduced bio-availability within the body are low intrinsic activity, poor absorption, high rate of metabolism, rapid elimination, and clearance from the body. So, the Curcumin is made into Curcumin gel formulation using carbopol, HPMC as polymers, PEG, Mannitol, SLS, and absorption enhancers. Curcumin was prepared and characterized for its physiochemical parameters like pH, color, and viscosity. Gel was made and then evaluated for drug release rate, % drug content, gelation temperature, pH, viscosity, kinetic analysis of drug release, and stability studies. Evaluation studies showed that the optimized curcumin gel has a better % drug release. Hence, the Curcumin gel of is considered a promising formulation for good therapeutic activity.

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