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Research Article

POLYHERBAL MICROEMULSION GEL FORMULATIONS: A NOVEL APPROACH FOR PSORIASIS TREATMENT

Ande S. N.*[1], Kshirsagar M. D. [1], Chandewar A. V. [1] and Kochar N. I. [1], Mohale D. S.[1]

[1]Department of pharmaceutical sciences, P. Wadhwani college of Pharmacy, Dhamangoan railway road, Yawatmal- 445001, Maharashtra, India.

Email: sagar986ande@gmail.com

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Abstract

Millions of people worldwide suffer from psoriasis, a chronic inflammatory skin condition characterised by inflammation, scaly plaques, erythema, and hyperproliferation of keratinocytes. Currently, no specific treatment is available for psoriasis**.** The objective of this study is to formulate and assess the efficacy of polyherbal formulations for the treatment of psoriasis. Herbal extracts including boswellic acid, curcumin, and glycyrrhizin were integrated into a microemulsion gel formulation aimed at alleviating symptoms of psoriasis. Similarly, a formulation comprising Azadirachtin, Berberis aristata, and Coleus forskohlii was developed to target inflammatory skin conditions. The present study employed pseudoternary phase diagrams to aid in the selection of microemulsion regions for formulations utilizing varying Smix ratios. Among these formulations, numbers 3 and 4 exhibited notably enhanced stability when compared to formulations 1 and 2. Viscosity assessments unveiled thixotropic behavior within both BCG-Microemulsion and ABC-Microemulsion gels. In vitro drug release investigations demonstrated sustained release profiles for Azadirachtin, Berberine, and Forskolin, with Azadirachtin exhibiting a faster release rate. Additionally, Boswellic acid, Curcumin, and Glycyrrhizin showcased sustained release patterns, with Boswellic acid demonstrating a faster release rate compared to Curcumin and Glycyrrhizin. The present study has centered on the formulation of polyherbal remedies aimed at addressing psoriasis and inflammatory skin conditions. These formulations incorporate a combination of herbs including boswellic acid, curcumin, and glycyrrhizin, alongside Azadirachtin, Berberis aristata, and Coleus forskohlii. Encapsulated within a microemulsion gel matrix, these formulations exhibit promising potential for the management of psoriasis and related inflammatory skin disorders.

Keywords: Boswellic, Curcumin, Glycerrhizin, microemulsion

1. Introduction

A persistent inflammatory skin condition that affects people all around the world is psoriasis. In individuals without psoriasis, skin cells produce thick patches known as squamous silvery patches within days of quickly growing and migrating to the epidermis. In healthy individuals, skin cells renew around every four weeks.[1] Psoriasis is treated with systemic medication therapy, phototherapy, and local treatment, depending on the severity. For mild to moderate psoriasis, local therapy with lotions and ointments containing corticosteroids or vitamin A/D analogues works well.[2] As a result of continuous medication use, psoriasis frequently recurs on occasion and the skin develops resistant to different therapies. However, these treatments are ineffective despite having fewer side effects because of their low efficacy. As a result, finding a successful psoriasis treatment is still a difficult task, and developing substitute therapies is required. Historically, natural products have been a great way to get active chemicals that help with psoriasis. Over the past few decades, natural goods have received a lot of attention due to their advantages of being typically safe and having minimal adverse effects.[3,4] The use of herbs to treat a wide range of illnesses has enormous potential.[5] Numerous herbal formulations, including Strobilanthes formosanus, Baphicacanthus cusia, Aloe vera, Capsicum frutescens, Curcuma longa, Hypericum perforatum, Indigo naturalis, Mahonia aquifolium, and Persea americana (avocado), have been studied in clinical investigations for their antipsoriatic characteristics.[6] Our present psoriasis treatment involves the preparation and evaluation of a polyherbal mixture.

Currently, a number of drug carriers, including nanoparticles, nanosuspensions, and microemulsions (ME), have made an effort to improve percutaneous penetration.[7] Transdermal ME has been frequently used in Nevertheless, the effect and use are limited by the low solubility and bioavailability. To get around these drawbacks, nanocarrier-based local drug delivery techniques were developed, such as enhancing drug permeability and making hydrophobic medications more soluble.[8] However, psoriasis patients have greater cholesterol, decreased ceramide levels, and an overabundance of keratinocytes, which causes an increase in scaly plaques that thicken and harden the skin.[9] ME is a thermodynamically stable system made up of co-surfactants, surfactants, and an aqueous phase as well as an oil phase. ME is classified into three categories: o/w, w/o, and bicontinuous phase. The o/w type ME significantly improves the solubility of medications with low water solubility.[10,11] The ME has the benefit of having high permeability and moisturizing properties. Following transdermal administration, it creates a drug depot in the skin to maximize the medication's effective penetration. ME diameters are also frequently small, which makes them an excellent drug delivery vehicle.[7] Therefore, ME has great potential for skin drug delivery.

Materials and methods

Selection of oils, surfactant and cosurfactant, gelling agent

Various oil phases, surfactants, and co-surfactants all have a significant impact on microemulsion formation. Surfactant and co-surfactant are important for droplet stability because they reduce surface tension. Adjuvants suited for the composition of the microemulsion system were screened in this study.[12]

Solubility testing (homogeneity)

Extract solubility testing

First, we chose the herbal drug by creating a formulation, and then we tested its solubility in various oils, surfactants, and co-surfactants by dissolving the excess of the herbal drug into it. We also chose the oil in a combination fashion.[13] Extract solubility testing with different – different oil, surfactants and co – surfactants were done (Table 1).

Table 1: Preparation of 5ml of Smix and Smix in percentage

Ratio	Surfactant (mL)	Co-surfactant (mL)	Ratio	Surfactant (%)	Co-surfactant (%)
1:1	2.5	2.5	1:1	50	50
1:2	1.7	3.4	1:2	33.33	66.67
1:3	1.25	3.75	1:3	25	75
2:1	3.4	1.7	2:1	66.67	33.33
3:2	3	2	3:2	60	40

Construction of pseudoternary phase diagram

Smix and pseudoternary study

Smix ratios of surfactants and cosurfactants are chosen. The excipients chosen from the solubility studies, namely oil, surfactant, and cosurfactant, were utilized to generate the pseudo-ternary phase diagrams using the water titration method. The pseudo-ternary phase diagrams were created in order to determine the Smix ratios at which the maximum microemulsion area forms. To satisfy the HLB value requirement (12-16), various Smix ratios were produced using varied quantities of surfactant and cosurfactant.[14]

Formulation of microemugel

Formulation F1-F6 Preparation

Firstly, prepare 5ml Smix which contains surfactant and co-surfactant with different ratios (1:1), (1:2), (1:3), (2:1), (3:2) (Table 1). Then prepare of 1ml (Smix: Oil) with different-different ratios (1:9), (2:8), (3:7), (4:6), (5:5), (6:4), (7:3), (8:2), (9:1) (Table 2). Formulation 1 contains Labrasol: Ethanol (surfactant: co- surfactant (Smix), Capryol-90 (oil), water (aqueous) Formulation 2 contains Tween-80: Propylene glycol (Surfactant: Co-surfactant), Isopropyl myristate (Oil) and water (Aqueous). Formulation 3 contains Capryol-90: Transcutol-HP (surfactant: co- surfactant (Smix), Tea tree oil (Oil) and water (Aqueous). Formulation 4 contains Tween-80: Transcutol-HP (surfactant: co- surfactant (Smix), Capryol-90 (Oil) and water (Aqueous) (Table 3). Formulation 1 and 2 also had a good unturbid area, but unfortunately, due to instability, they were not considered for further emulsion preparation. Therefore, formulation 3 and 4 specified Smix concentration were selected for further studies (Table 4). BCG emulsion contains 1% Boswellia serrata + 1% Curcuma longa + 1% Glycyrrhiza glabra with formulation 3 undergo various formulation ratio (Table 5). From 6 formulation, the formulation (F3-6) exhibited less settling of impurities and good stability was selected for evaluation. ABC emulsion contains 1% Azadirachta indica + 1% Berberis aristata + 1% Coleus forskohli with formulation 4 undergo various formulation ratios (Table 5). From

6 formulation, the formulation (F4-6) exhibited less settling of impurities and good stability was selected for evaluation.

Table 2: Preparation of 1 mL (Smix : Oil)

Smix: Oil ratio	Smix-1:1 (µL)	Oil (µL)	Smix-1:2 (µL)	Oil (µL)	Smix-1:3 (µL)	Oil (µL)	Smix-2:1 (µL)	Oil (µL)	Smix-3:2 (µL)	Oil (µL)
1 : 9	100	900	100	900	100	900	100	900	100	900
2 : 8	200	800	200	800	200	800	200	800	200	800
3 : 7	300	700	300	700	300	700	300	700	300	700
4 : 6	400	600	400	600	400	600	400	600	400	600
5 : 5	500	500	500	500	500	500	500	500	500	500
6 : 4	600	400	600	400	600	400	600	400	600	400
7 : 3	700	300	700	300	700	300	700	300	700	300
8 : 2	800	200	800	200	800	200	800	200	800	200
9 : 1	900	100	900	100	900	100	900	100	900	100

Table 3: Formulations

ID	Formulation (solvent / cosolvent : Oil : Aqueous phases)	Stability
Formulation-1	Labrasol / Ethanol : Capryol-90 : Water	Poor
Formulation-2	Tween-80 / Propylene glycol : Isopropyl myristate : Water	Poor
Formulation-3	Capryol-90 / Transcutol-HP : Tea tree oil : Water	Good
Formulation-4	Tween-80 / Transcutol-HP : Capryol-90 : Water	Good

Table 4: Stable formulations

Formulation-3				**Formulation-4**			
Smix : Oil	Smix-1:1 (%)	Oil (%)	Aqueous (%)	Smix : Oil	Smix-1:1 (%)	Oil (%)	Aqueous (%)
8 : 2	66.7	16.7	16.7	6 : 4	35.3	23.5	41.2
9 : 1	71.4	7.9	20.6	7 : 3	26.9	11.5	61.5
Smix : Oil	Smix-1:2 (%)	Oil (%)	Aqueous (%)	Smix : Oil	Smix-1:2 (%)	Oil (%)	Aqueous (%)
8 : 2	61.5	15.4	23.1	6 : 4	41.1	27.4	31.5
9 : 1	64.3	7.1	28.6	7 : 3	35.0	15.0	50.0
Smix : Oil	Smix-1:3 (%)	Oil (%)	Aqueous (%)	Smix : Oil	Smix-1:3 (%)	Oil (%)	Aqueous (%)
8 : 2	58.8	14.7	26.5	4 : 6	33.3	50.0	16.7
9 : 1	62.1	6.9	31.0	5 : 5	39.7	39.7	20.6

Preparation of microemulsion gel

Depending upon the solubility of extracts, four formulations are selected. For every formulation mix surfactant and co-surfactant in the following ratio (1:1), (1:2), (1:3), (2:1),

(3:2). And for every Smix of every formulation and Oil in the following ratios (1:9), (2:8), (3:7), (4:6), (5:5), (6:4), (7:3), (8:2), (9:1) and vortex for 5 min. Continue mixing for 30 min. Add water drop by drop on continuous mixing until turbidity appears. Wait for disappearing turbidity and continue adding water for turbidity is the indication of formulation of emulsion and preparation of Carbopol based gel containing microemulsion.

Optimization of formulation

The prepared formulation was optimized by calculating various physiochemical parameters as mentioned below.

Physiochemical Evaluation and estimation

Tube test (extrudability test) [15]

The tube test is an empirical procedure used to measure the amount of force needed to extrude material from a tube. The collapsible tubes were filled with the mixtures. The weight in grams required to extrude a 0.5 cm ribbon of ME gel in 10 seconds was used to measure the formulation's extrudability. It was determined and noted what proportion of the ME gel was extruded. There was a grade assigned. Good ++, Excellent +++, and Satisfactory+.

Table 5: F3 and F4 Formulations (1-6 Selected)

ID	**Formulation-3**				**Weight of extracts (1%) (mg)**			**Preperation of 1mL BCG Emulsion**			**Total (µL)**	**Sedimentation**
	Smix : Oil	**Smix- 1:1 (%)**	**Oil (%)**	**Aqueous (%)**	**Boswellia Serrata**	**Curcuma Longa**	**Glycyrrhiza glabra**	**Smix- 1:1 (µL)**	**Oil (µL)**	**Aqueous (µL)**		
F3-1	8 : 2	66.7	16.6	16.7	10	10	10	667.0	166.0	167.0	1000	More
F3-2	9 : 1	71.4	7.9	20.7	10	10	10	714.0	79.0	207.0	1000	Minimum
	Smix : Oil	Smix- 1:2 (%)	Oil (%)	Aqueous (%)	Boswellia Serrata	Curcuma Longa	Glycyrrhiza glabra	Smix- 1:2 (µL)	Oil (µL)	Aqueous (µL)		
F3-3	8 : 2	61.5	15.4	23.1	10	10	10	615.0	154.0	231.0	1000	More
F3-4	9 : 1	64.3	7.1	28.6	10	10	10	643.0	71.0	286.0	1000	Minimum
	Smix : Oil	Smix- 1:3 (%)	Oil (%)	Aqueous (%)	Boswellia Serrata	Curcuma Longa	Glycyrrhiza glabra	Smix- 1:3 (µL)	Oil (µL)	Aqueous (µL)		
F3-5	8 : 2	58.8	14.7	26.5	10	10	10	588.0	147.0	265.0	1000	More
F3-6	9 : 1	62.1	6.9	31.0	10	10	10	621.0	69.0	310.0	1000	Less
F4-1	6 : 4	35.3	23.5	41.2	10	10	10	353.0	235.0	412.0	1000	More
F4-2	7 : 3	26.9	11.6	61.5	10	10	10	269.0	116.0	615.0	1000	More
	Smix : Oil	Smix- 1:2 (%)	Oil (%)	Aqueous (%)	Azadirachta Indica	Berberis Aristata	Coleus Forskohli	Smix- 1:2 (µL)	Oil (µL)	Aqueous (µL)		
F4-3	6 : 4	41.1	27.4	31.5	10	10	10	411.0	274.0	315.0	1000	More
F4-4	7 : 3	35.0	15.0	50.0	10	10	10	350.0	150.0	500.0	1000	More
	Smix : Oil	Smix- 1:3 (%)	Oil (%)	Aqueous (%)	Azadirachta Indica	Berberis Aristata	Coleus Forskohli	Smix- 1:3 (µL)	Oil (µL)	Aqueous (µL)		
F4-5	4 : 6	33.3	50.0	16.7	10	10	10	333.0	500.0	167.0	1000	Less
F4-6	5 : 5	39.7	39.7	20.6	10	10	10	397.0	397.0	206.0	1000	Less

Spreadability measurement [16]

The degree to which ME gel spread easily after being applied to skin was expressed using a spreadability measurement. A second glass plate was placed over the first, and 0.5 g of ME gel was spread out within a pre-marked circle with a diameter of 1 cm to assess the spreadability. For five minutes, a 500 g weight was left to rest on the upper glass plate. The spreading is recorded, and the diameter growth was attributed to the micro-gel. It was calculated by using the formula.

$S = M \times L/T$

M = wt. tied to upper slide; L = length of glass slides; T = time taken to separate the slides

Viscosity [17]

The ME gel's viscosity was assessed using a Brookfield viscometer (Model RVTDV II). 50 g of precisely weighed gel was added to a 50 ml glass beaker. The chosen spindle, number six, is submerged in the ME gel. After the reading stabilized, the viscometer was run at 10 revolutions per minute, and the reading was recorded

Measurement of pH [17]

Using a digital pH meter (Digital pH meter, Systronics), the pH of ME gel was determined. The data were collected in triplicate, and the average of the data was then evaluated.

Particle size analysis (Scanning electron microscopy) [18]

Using a Quanta 200 scanning electron microscope, scanning electron microscopy was used to determine the particle size of the ME gel. The ME gel was examined at magnifications ranging from 10X to 100,000X to determine its size, topography, and elemental composition. A slab was lightly coated with a concentrated aqueous dispersion of ME gel, which was then vacuum-dried. The sample was placed under a 20 nm thick layer of gold in a cathodic evaporator. The gel's surface morphology was examined.

Differential scanning calorimetry (DSC)

Using a DSC 7020 device, differential scanning calorimetry (DSC) study was carried out. For each sample, five milligrams were taken and put within an aluminum pan designed especially for DSC analysis [19]. The samples were then subjected to a nitrogen purge at a rate of 50 mL/min while being heated to between 30 and 300 ◦C at a rate of 10 ◦C.

In vitro drug release

***In vitro* study**

The cumulative drug release was determined in both formulation (BCG microemulsion and ABC emulsion) using dissolution apparatus.

Drug release

The mice, BALB/c, had previously been used for regular pharmacological tests. The non-dermatological skin was removed from the mice with a scalpel, and the full-thickness skin was harvested. Following a cold tap water wash, the skin was left to incubate for an entire night in phosphate buffer saline (PBS/pH 7.4). Inside the Franz diffusion cell, the skin was positioned between the donor and receptor compartments. The receptor compartment was filled with phosphate buffer saline (PBS), pH 7.4, and each formulation, weighing approximately 1 g, was placed in a donor compartment. A constant temperature of 37±2 °C was maintained for the diffusion cell apparatus during the experiment. 1.0 ml of sample was taken from the receptor compartment and replaced with an equivalent volume of fresh buffer solution at predefined intervals (0.083, 0.25, 0.5, 1, 2, 4, 6, 8, and 24 h) in order to maintain sink condition. Regression

equations taken from the reference graph were used to compute the percentage cumulative drug release from the formulations.

Drug content

Accurately weighed 1g microemulsion hydrogel was collected in a 20 mL tube, to this 5mL of methanol: PBS (50:50) was added. To make sure all of the chemicals were extracted, the mixture was stirred for a further fifteen minutes. Following this, any solid particles in the extract were removed by centrifuging it for 10 minutes at 6000 RPM. The supernatant was then collected for HPLC analysis. For HPLC analysis (Table 6,7). The percentage drug content was calculated using comparative peak area ratio method (by comparing peak area ratio of the sample with the peak area ratio of the standard) with certified standards.

Table 6: LC-PDA Conditions for ABC Formulation

LC-PDA Conditions for ABC Formulation		
Instrument:		
UFLC-Shimadzu		
Software:	Labsolutions	
Autosampler: SIL 20AC		
Moblie Phase:		
A: 0.1% Trifluoro acetic acid in milli-Q water		
B: 100% Acetonitrile		
Column:		
Shimadzu C18, 250*4.6 mm, 5 µm (Shimpack solar)		
Injection volume : 20 uL		
Method type: Isocratic		
METHOD		
Flow rate: 1.8	1 mL/min	
Time (min)	A (%)	B (%)
0.01	30	70
110.1	Controller	Stop

Table 7: LC-PDA Conditions for BCG Formulation

LC-PDA Conditions for BCG Formulation	
Instrument:	
UFLC-Shimadzu	
Software:	Labsolutions
Autosampler: SIL 20AC	
Moblie Phase:	
A: 0.1% Formic acid in milli-Q water	
B: 100% Acetonitrile	
Column:	
Shimadzu C18, 250*4.6 mm, 5 µm (Shimpack solar)	
Injection volume : 20 uL	
Method type: Gradient	

METHOD		
Flow rate: 1.8	**1 mL/min**	
Time (min)	**A (%)**	**B (%)**
0.01	50	50
3	50	50
3.01	5	95
12	5	95
12.01	50	50
15	Controller	Stop

Results

The developed herbal formulations for the ME gel ABC and BCG were translucent and had greenish yellow and yellowish grey colours, respectively. There were no lumps present and the resulting ME gel displayed good homogeneity. The microemulsion gels with pH values of 5.62 for ABC and 5.78 for BCG were measured. The BCG and ABC formulation had spreadabilities of 2.24 and 2.5 cm/s and 2.75 and 2.90 cm/s, respectively. The results are shown in Table 8,9.

Viscosity Studies

The viscosity of BCG-Microemulsion gel was 42604 centi Poise or mPa.s at 28.6 ℃ when the L4 spindle was rotating at an RPM of 10. The viscosity of ABC-Microemulsion gel was 56391 centi Poise or mPa.s at 28.6 ℃ when the L4 spindle was rotating at an RPM of 10 (Table 8). As both Microemulsion gels were showing thixotrophic nature, the viscosity changes with temperature, for repeatability in measurements, or for comparision with other samples, viscosity should be measured using the same instrument / spindle / RPM / experimental conditions.

Table 8: BCG and ABC Microemulsion gel

BCG-Microemulsion gel (Formula 1: Psoriasis (Imiquimod induced))						
S.NO	**Speed (RPM)**	**Viscosity (mPas)**	**Torque (%)**	**Temperature (℃)**	**Spindle**	**pH**
1	2	90713	30.2	28.6	L4	5.78
2	4	64930	43.3	28.6	L4	
3	6	56575	56.6	28.6	L4	
4	8	47980	64	28.6	L4	
5	10	42605	71	28.6	L4	
6	12	40858	81.7	28.6	L4	
7	14	39896	93.1	28.6	L4	
ABC-Microemulsion gel (Formula 2: Skin inflammation (UV B))						
8	2	155681	51.9	28.6	L4	5.62
9	4	101076	67.4	28.6	L4	
10	6	87027	87	28.6	L4	
11	8	76897	102	28.6	L4	
12	10	56391	103	28.6	L4	

Pseudoternary Phase Diagram

The phase diagram was constructed comprising different -different Smix ratio (Labrasol/Ethanol) i.e., 1:1, 1:2, 1:3, 2:1, 3:2 for formulation 1 (Figure 1), Tween-80/Propylene glycol i.e., 1:1, 1:2, 1:3, 2:1, 3:2 for formulation 2 (Figure 2), Capryol-90/Transcutol-HP i.e., 1:1, 1:2, 1:3, 2:1, 3:2 for formulation 3 (Figure 3) and Tween-80 : Transcutol-HP i.e., 1:1, 1:2, 1:3, 2:1, 3:2 for formulation 4 (Figure 4). These phase diagram helped in determination/selection of microemulsion region with desired concentration range of components that is oil, Smix and water.

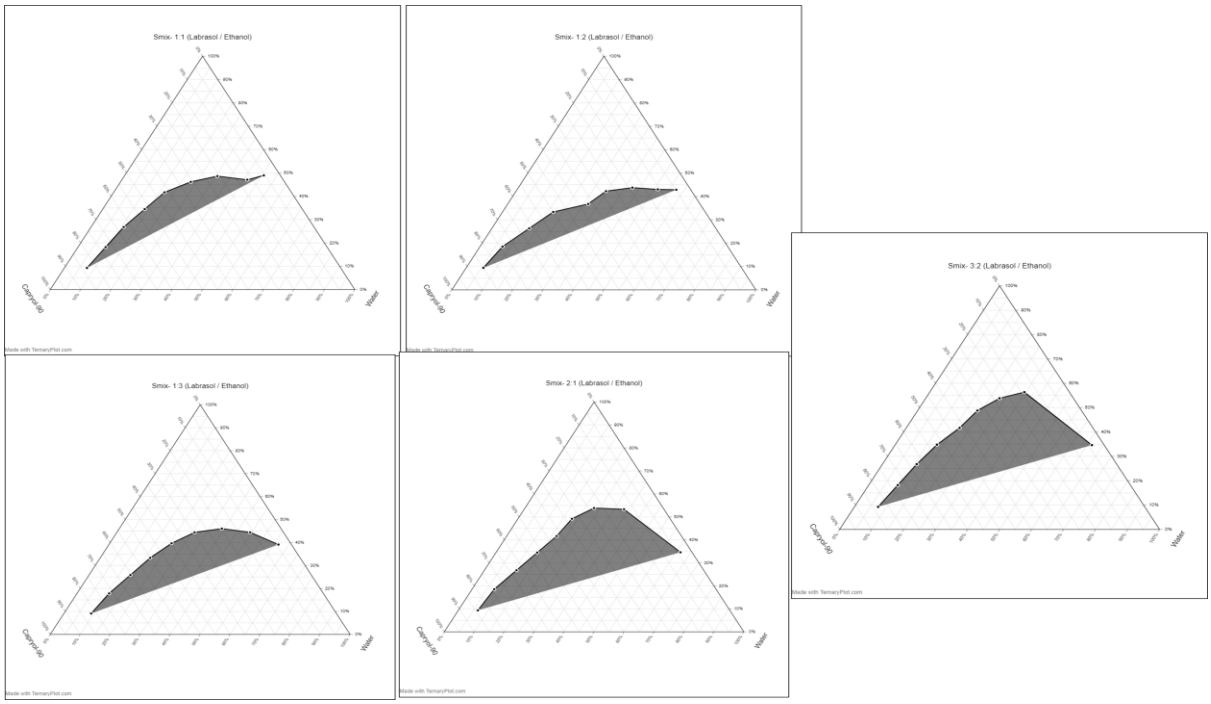


Figure 1: Smix ratio (Labrasol/Ethanol) i.e., 1:1, 1:2, 1:3, 2:1, 3:2

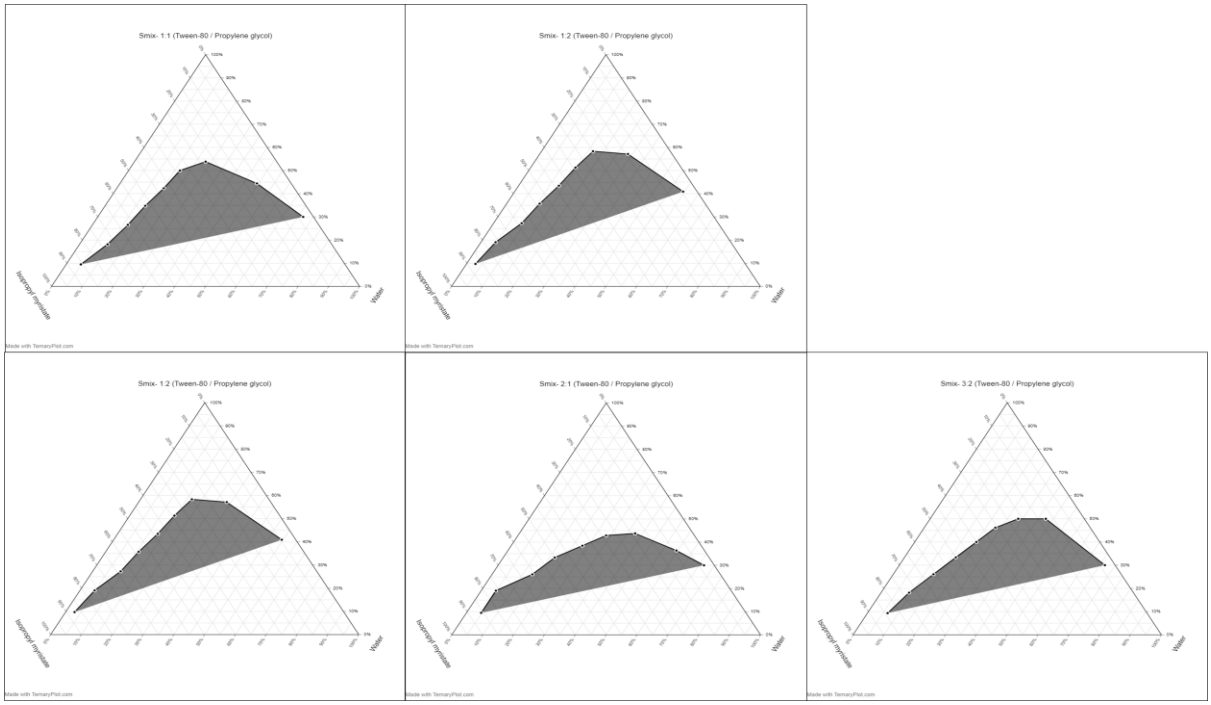


Figure 2: Tween-80/Propylene glycol i.e., 1:1, 1:2, 1:3, 2:1, 3:2

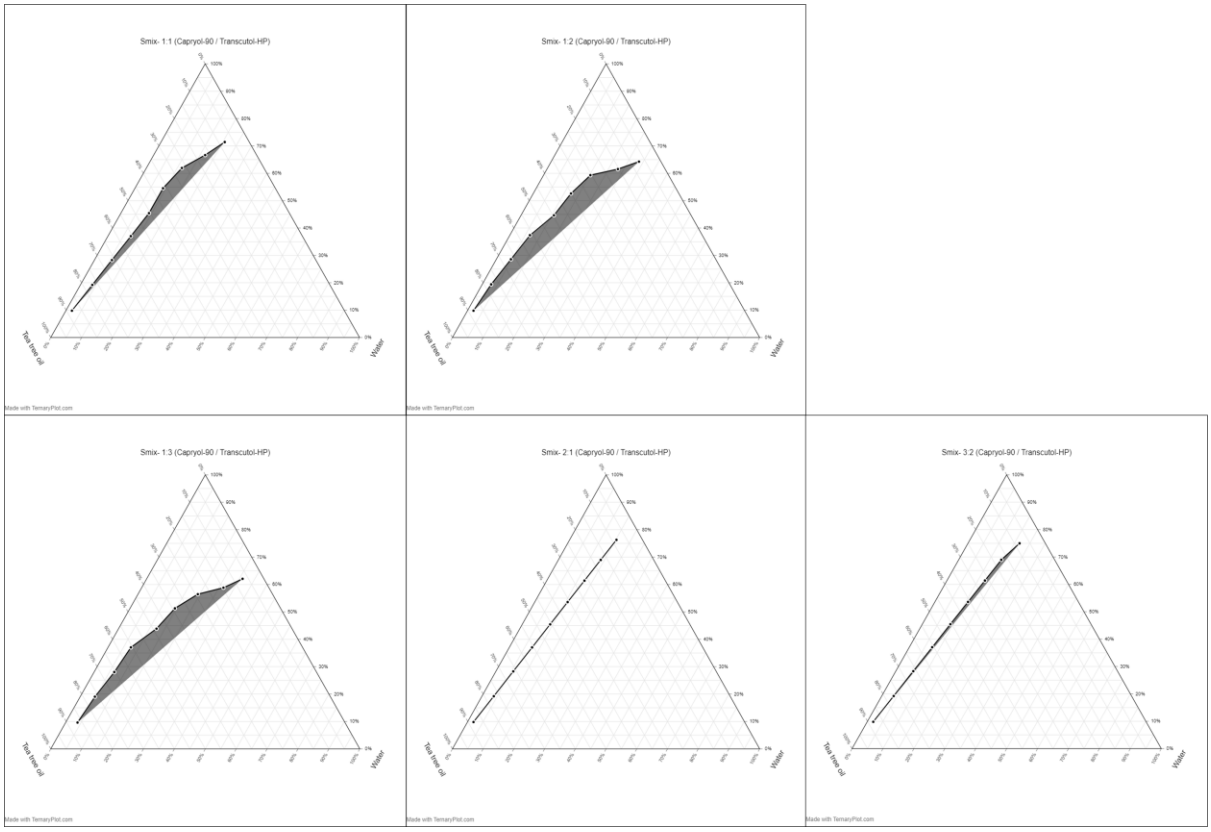


Figure 3: Capryol-90/Transcutol-HP i.e., 1:1, 1:2, 1:3, 2:1, 3:2

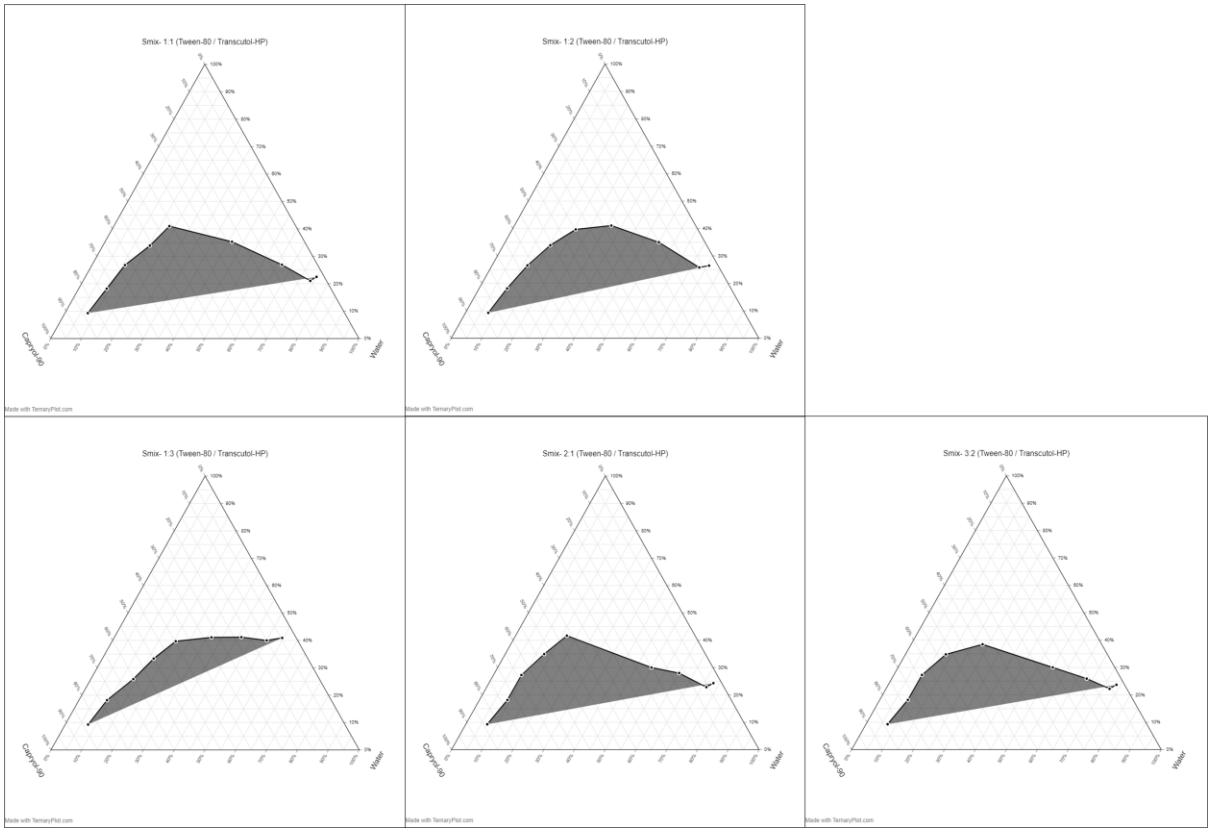


Figure 4: Tween-80: Transcutol-HP i.e., 1:1, 1:2, 1:3, 2:1, 3:2

Preparation of formulation

The ratio of surfactants and co-surfactants as well as Smix and oil have been presented in table 1 and table 2.

Stability

We have observed good stability of formulation 3 and 4 as compared to formulation 1 and 2. The results are compiled in table 3.

Evaluation of the formulations

The particle sizes of formulations were found in acceptance range as shown in figure 5 and 6 (table 9 (a, b)). Florescence microscopy evident that the average size of the observed globules is around 600 to 700 nm, with some variations around this average size indicated by the differences between midpoint size (d) and the average size (m) as well as the corresponding squared differences (Figure 7).

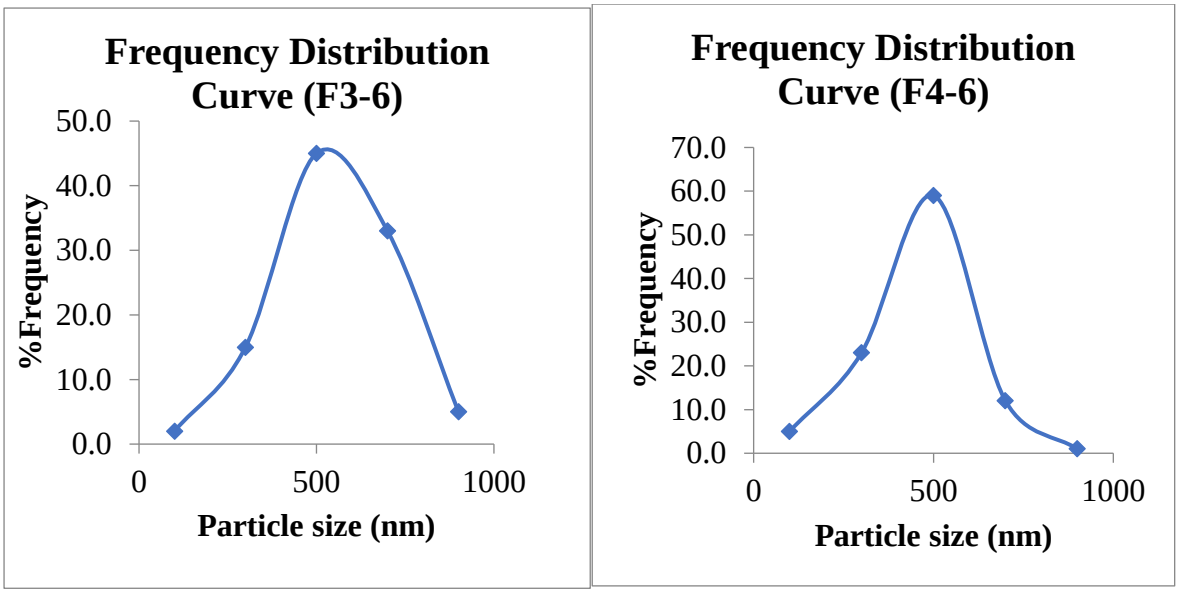


Figure 5: Particle size distribution (F3-6) and (F4-6)

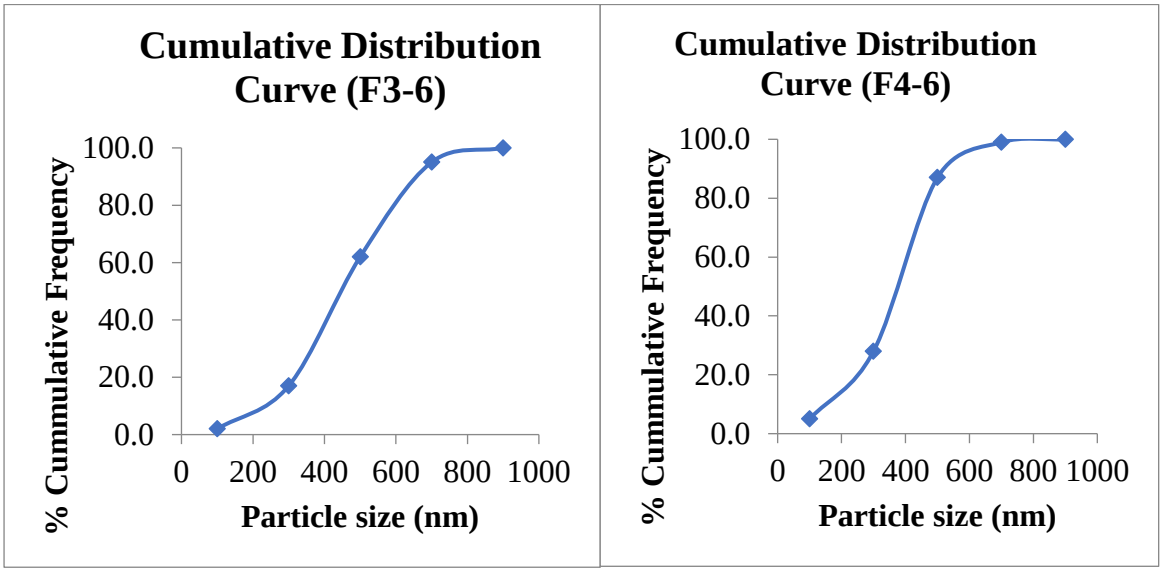
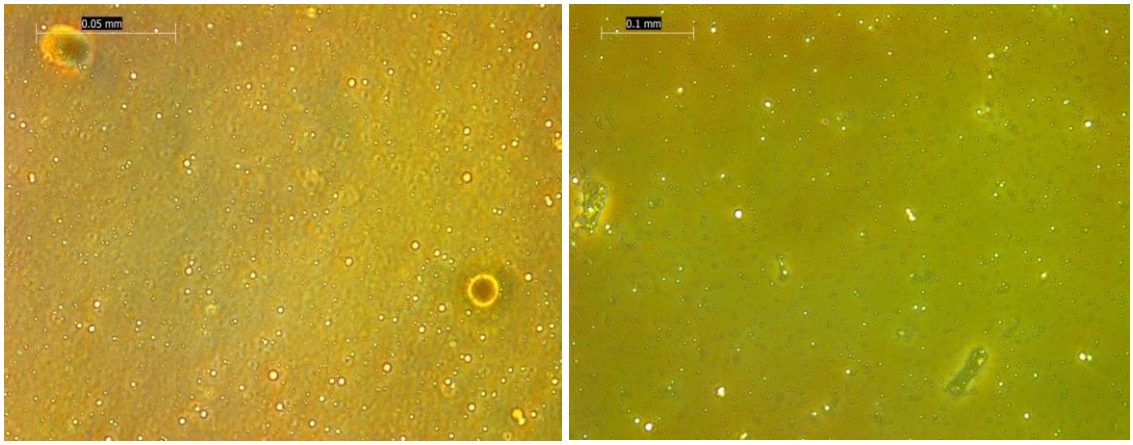


Figure 6: Cumulative distribution curve (F3-6) and (F4-6)



(a) **(b)**

Figure 7. Florescence microscopy of (a) ABC Emulsion; (b) BCG microemulsion

Table 9(a) – Particle size distribution

F3-6 Formulation particle size	
Formulation-3	Capryol-90 / Transcutol-HP **:** Tea tree oil **:** Water
BCG Emulsion	1% Boswellia Serrata + 1% Curcuma Longa + 1% Glycyrrhiza glabra

S.No	**Range (nm)**	**midpoint (d) (nm)**	**Frequency (n)**	**% Frequency**	**% Cumulative Frequency**	**n*d**	**d-m**	**(d-m)^2**	**(d-m)^2 n**
1	0 to 200	100	2	2.0	2.0	200.0	-400	160000	320000
2	200 to 400	300	15	15.0	17.0	4500.0	-200	40000	600000
3	400 to 600	500	45	45.0	62.0	22500.0	0	0	0
4	600 to 800	700	33	33.0	95.0	23100.0	200	40000	1320000
5	800 to 1000	900	5	5.0	100.0	4500.0	400	160000	800000
Total			**100**	**100.0**		**54800.0**			3040000

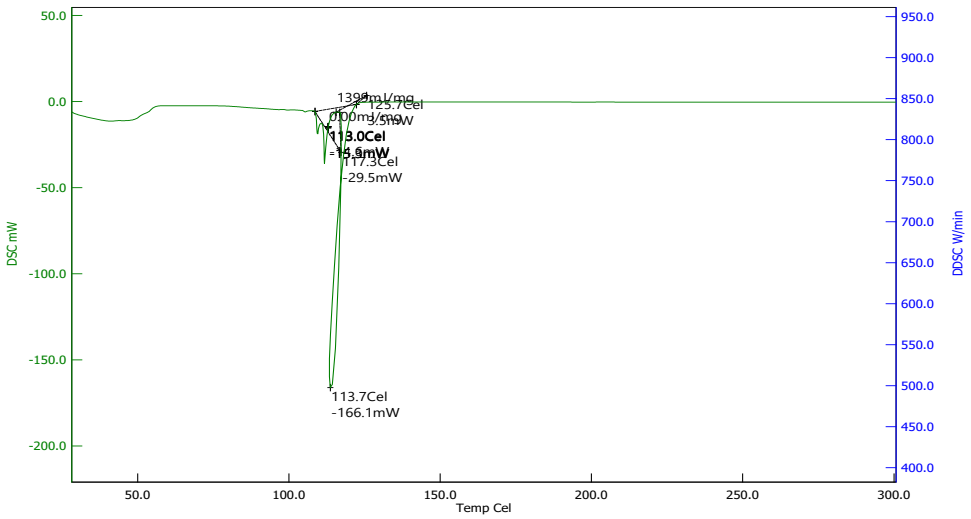
Table 9(b) – Particle size distribution

F4-6 Formulation particle size	
Formulation-4	Tween-80 / Transcutol-HP : Capryol-90 : Water
ABC Emulsion	1% Azadirachta Indica + 1% Berberis Aristata + 1% Coleus Forskohli

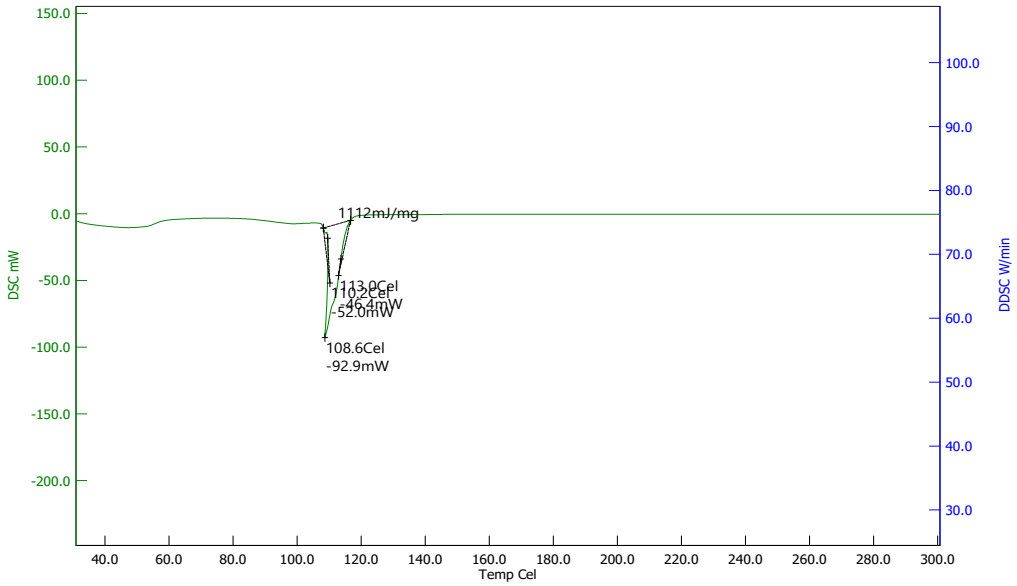
S.No	**Range (nm)**	**midpoint (d) (nm)**	**Frequency (n)**	**% Frequency**	**% Cumulative Frequency**	**n*d**	d-m	$(d-m)^2$	$(d-m)^2 n$
1	0 to 200	100	5	5.0	5.0	500.0	-400	160000	800000
2	200 to 400	300	23	23.0	28.0	6900.0	-200	40000	920000
3	400 to 600	500	59	59.0	87.0	29500.0	0	0	0
4	600 to 800	700	12	12.0	99.0	8400.0	200	40000	480000
5	800 to 1000	900	1	1.0	100.0	900.0	400	160000	160000
Total			**100**	**100.0**		**46200.0**			2360000

DSC

DSC provided the information about the physical properties of the formulations and demonstrated a possible interaction between drug and polymers in formulations. DSC results have shown no effect of nature and physical state of the encapsulated drug in a polymer matrix on its release (Figure 8 (a, b)).



(a)

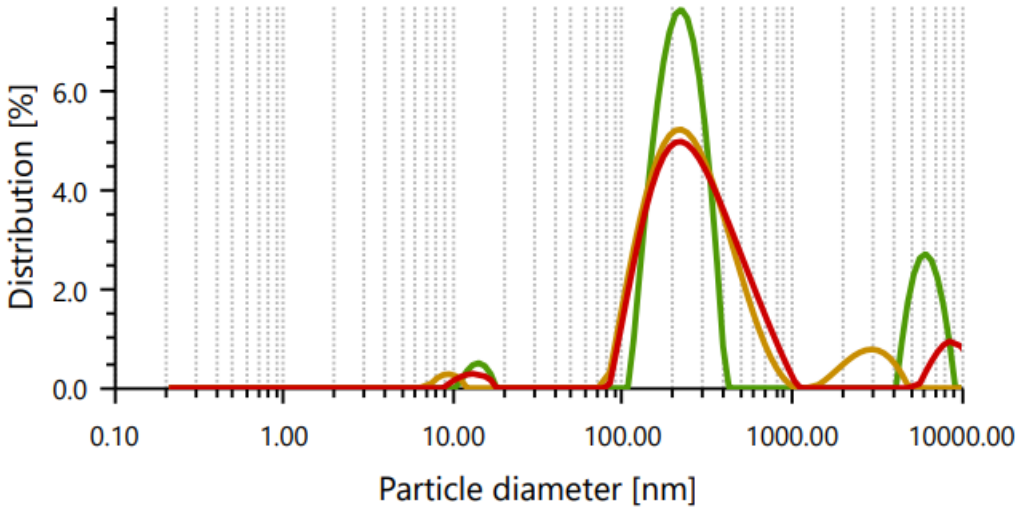


(b)

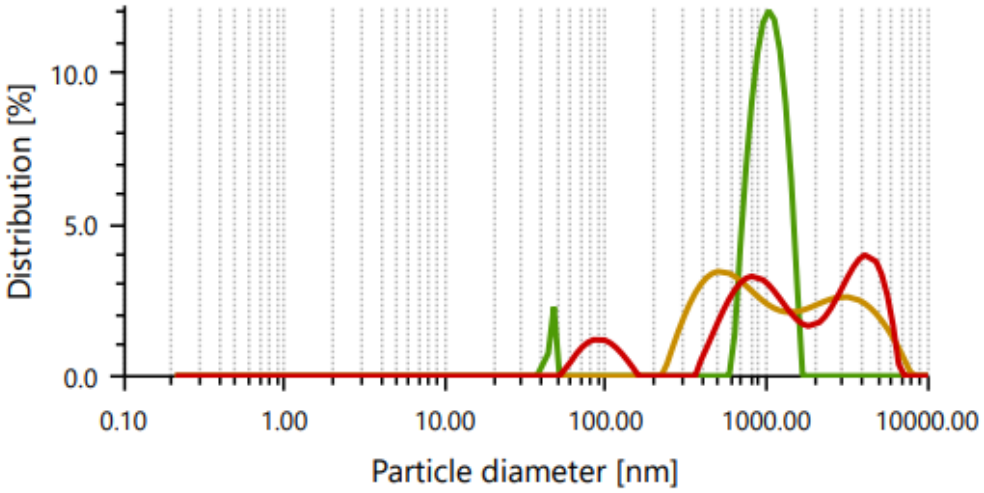
Figure 8: DSC of (a) ABC formulation; (b) BCG formulation

Particle size

The mean particle size of ABC formulation was found to be 269.9nm with standard deviation of 9.59 as shown in figure 9. The mean particle size of BCG formulation was found to be 1169.7 nm with standard deviation of 173.77 as shown in figure. The zeta potentials for ABC and BCG formulation were -23.2 mV and -25.2mV respectively.



(a)

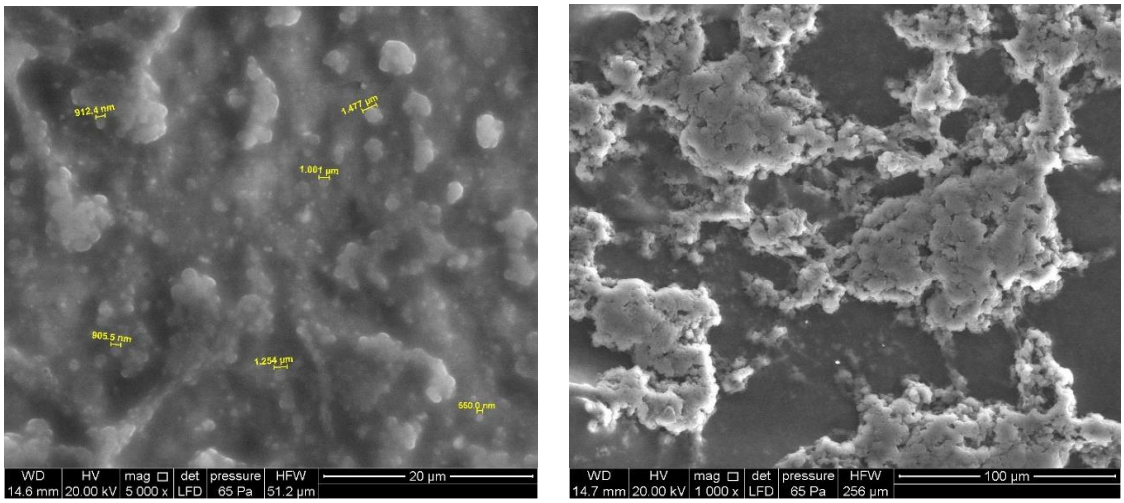


(b)

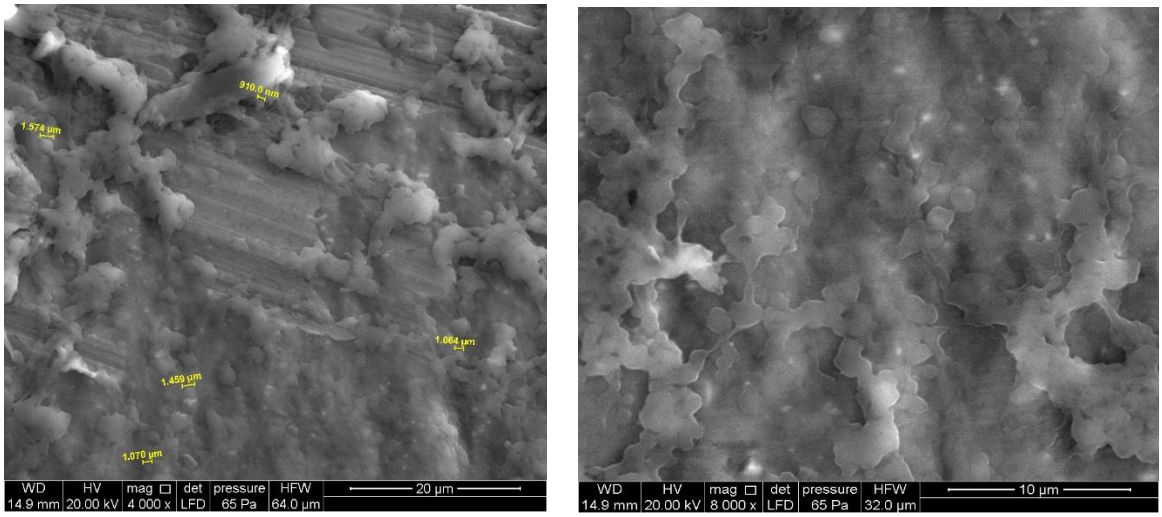
Figure 9: Particle size of (a) ABC formulation; (b) BCG formulation

SEM Analysis

Particle size plays a crucial role in the easy release and penetration of ME formulation via the epidermis, making it an essential component of the formulation process. Larger surface area and faster medication release are made possible by nanoscale droplets that help pierce the multilayered skin structure.[20] Additionally, it was observed that a high concentration of Smix in ME helps to reduce the liquid size.[21] An additional metric that illustrates the homogeneity of droplets in a formulation is the polydispersity index (PDI). A PDI nearer 0 denotes more homogeneous nanoparticles. Additionally, the negative charge on the ME droplets' surface aids in their penetration of the skin (Figure 10).



(a) **(b)**

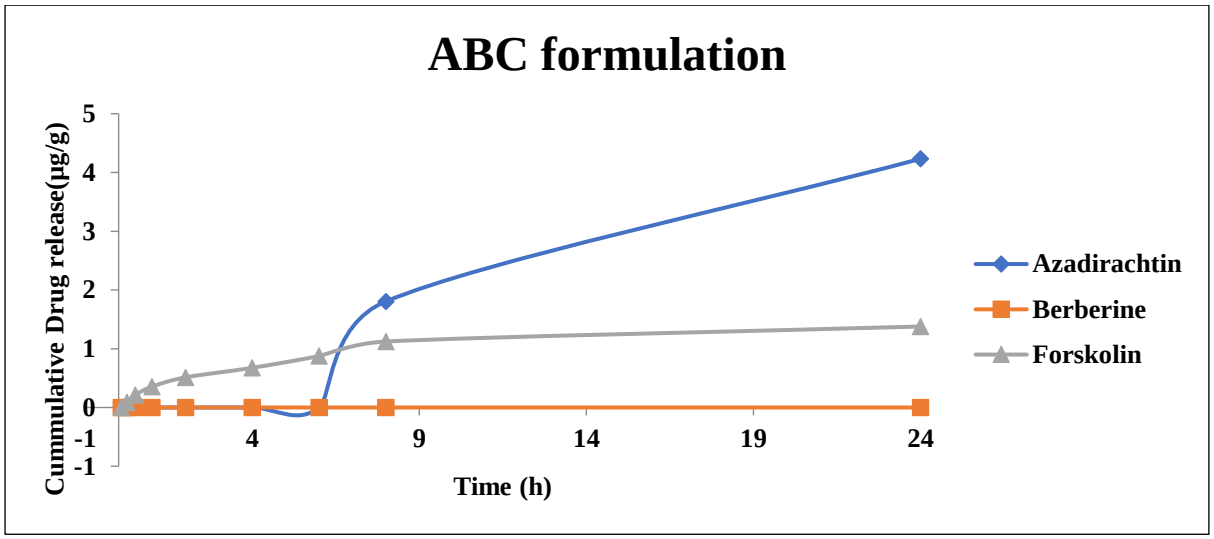


(c) **(d)**

Figure 10: SEM images of ABC formulation (a, b); BCG formulation (c, d).

***In Vitro* drug release study**

Figure 11 depicts the cumulative release profile of Azadirachtin, Berberine, Forskolin extract from ABC microemulsion gel respect to time. It was noticed that Azadirachtin, Berberine, Forskolin extract were released respectively, in a sustained manner up to 24 h. Plotting the log of cumulative release data against the log of time allowed for the analysis of the drug release kinetics. Which shows that Azadirachtin release faster than the Berberine and forskolin. It was noticed that Boswellic acid, Curcumin, Glycyrrhizin extract was released respectively, in a sustained manner up to 24 h. The drug release kinetics was analysed by plotting the log of cumulative release data versus log of time. Which shows that Glycyrrhizin release faster than the Curcumin and Boswellic acid.



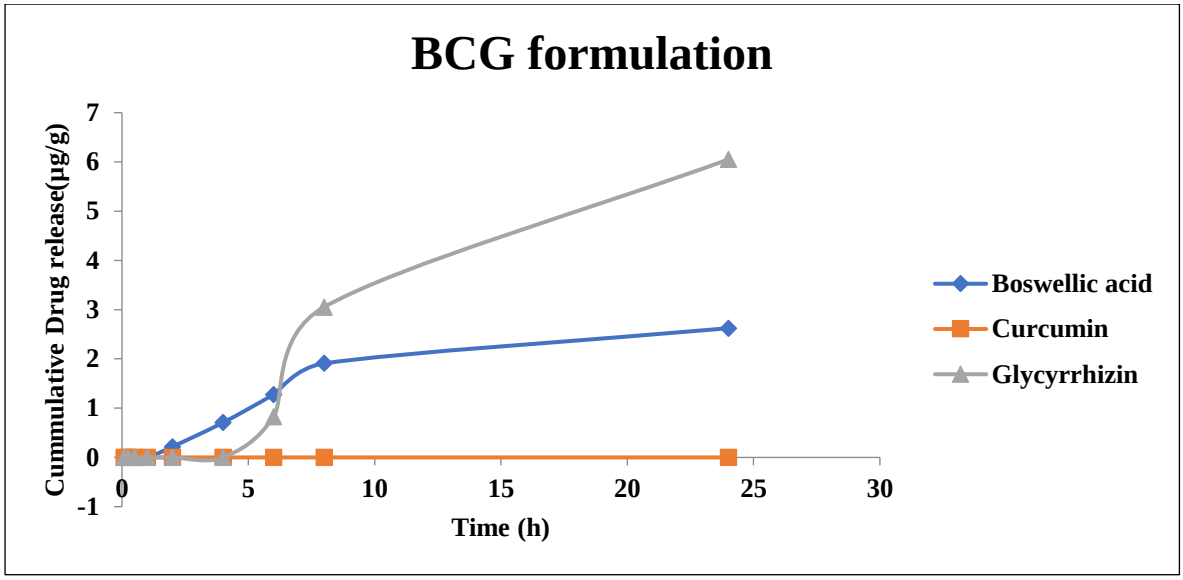


Figure 11: Cumulative drug release different emulsions.

4. Discussion

Psoriasis, a chronic autoimmune affliction, poses significant pain and detriment to patients, impacting their quality of life and functional abilities. Psoriasis commonly afflicts individuals across all age groups, predominantly affecting those between 50 and 69 years. Its global prevalence underscores the gravity of psoriasis as a widespread and serious health concern worldwide.[22] The etiology of psoriasis is not clear, although genetic predisposition is a major concern. Psoriasis, a multifaceted disease, is influenced by diverse factors, including external triggers such as trauma, infections, drugs, and internal factors like stress. Around 2-3% of individuals with psoriasis develop psoriatic arthritis that leads to joint deformations and disability. Psoriasis causes great physical, emotional and social burden.[23,24] Social exclusion, perception and disgrace are psychologically upsetting for individuals and their families suffering from psoriasis. Treatment of psoriasis is still symptomatic. For mild to moderate psoriasis, topical therapies are the preferred approach. Commonly used topical drugs include calcineurin inhibitors, anthralin, corticosteroids, retinoids, vitamin D3 analogs, and tar-based formulations. Systemic approaches, especially non-biologic ones, are restricted in treating moderate to severe psoriasis due to associated toxicity concerns. Despite the advancements in disease management through systemic and biologic approaches, topical delivery remains a preferred choice for psoriasis therapy.

The effective management of psoriasis can be enhanced through a comprehensive understanding of the role and application of natural medicinal herbs. Extensive studies on plant extracts and phyto-constituents have been conducted, providing valuable insights into their potential for psoriasis management. The treatment of psoriasis using *Angelica dahurica* Fisch root extract has been reported. The root extracts facilitate the degeneration of psoriatic cells and recovery of basal cells multiplication.[25] Wu et al., explored the potential of baicalin in psoriasis. He suggested that the topical application of baicalin based cream exerts anti-inflammatory effects and stimulates normal keratinization.[26] An et al., mentioned that the application of amentoflavone in the effective treatment of psoriasis.[27] Kang et al., studied anti-psoriatic efficacy of Curcumin NLC hybridized with cellulose nanofibers.[28] These results of

study indicated the high deposition of Curcumin in the skin due to skin hydrating property of film. They suggested development of these types of hydrating system as a promising topical drug delivery system for psoriasis therapy. In 2018, Song and his team proposed a cream formulation containing *Artemisia capillaris* extract for psoriasis therapy with safe and conveniently used for psoriasis treatment.[29] Above mentioned work carried out by several international researchers in this area will give us idea about the use of plant extracts, phyto-constituents based topical therapy for psoriasis treatment. In the current investigation, we have developed and evaluated the two different polyherbal formulation for the treatment of psoriasis. One of the polyherbal formulation contains boswellic, curcumin, and glycerrhizin whereas the other formulation contains Azadirachtin, barberia Arista and coleus forskohill.

5. Conclusion

In conclusion, the study aimed to develop and assess polyherbal formulations for treating psoriasis symptoms using selected herbs. The incorporation of boswellic, curcumin, and glycerrhizin in one formulation and Azadirachtin, barberia Arista, and coleus forskohill in another, within a microemulsion gel medium, provides a potential avenue for addressing psoriasis and inflammatory skin conditions.

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