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Formulation and Evaluation of Polyherbal Topical Gel for Treatment of Acne

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Abstract

Nowadays, cosmetics are becoming more high demand in daily life, and it was used frequently by many of people per year. Mankind uses various products to enhance beauty and elegance to look young and charming. Thus, cosmetics play a vital role in human life. Now days, herbal cosmetic are widely used because of the belief that they have fewer side effects and better safety. Acne vulgaris is a prevalent skin disorder affecting millions of individuals worldwide, characterized by the formation of comedones, papules, pustules, and nodules. The multifaceted nature of acne involves sebum overproduction, inflammation, and microbial colonization, necessitating the search for effective and safe therapeutic options. Natural compounds, such as protocatechuic acid (PCA) and curcumin, have emerged as promising candidates for managing acne due to their anti-inflammatory, antioxidant, and antimicrobial properties. The combination of PCA and curcumin presents an intriguing prospect for acne management. Their complementary actions, including anti-inflammatory, antioxidant, and antimicrobial effects, could synergistically address multiple aspects of acne pathogenesis. However, optimal dosages, formulations, and safety profiles need further exploration. In conclusion, protocatechuic acid and curcumin exhibit promising potential as anti-acne agents due to their multifaceted properties. While preclinical studies highlight their efficacy in modulating inflammation, oxidative stress, and microbial growth, clinical trials are needed to validate their effectiveness in human subjects. Embracing these natural compounds could lead to the development of novel, holistic approaches for acne treatment, potentially reducing the reliance on conventional therapies with associated side effects.

Keywords

Cosmetic, Topical gel, Acne, Anti-inflammatory, PCA, Curcumin.

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INTRODUCTION

Acne vulgaris, commonly referred to as acne, is a prevalent skin condition that affects individuals across various age groups, genders, and ethnicities.(1) It is characterized by the development of various types of lesions, including comedones (blackheads and whiteheads), papules, pustules, nodules, and potentially cysts. Acne primarily occurs on areas of the skin rich in sebaceous (oil) glands, such as the face, chest, back, and shoulders. While often considered a cosmetic concern, acne can have significant physical and psychological impacts on those affected, influencing self-esteem and quality of life.(1)(2)

Nowadays, cosmetics are becoming more high demand in daily life, and it was used regularly by many of people per year. Mankind uses various products to enhance beauty and elegance to look young and charming. Cosmetics thus play a vital role in human life. The herbal cosmetic are widely used because of the belief that they have fewer side effects and better safety.(3)(4)

Topical gels offer a localized and targeted approach to treating acne lesions. Their formulations can incorporate a range of active ingredients with anti-inflammatory, antimicrobial, and keratolytic properties. This abstract highlights the key components of topical gels and their mechanisms of action in acne treatment.(5)

PCA, a naturally occurring phenolic acid found in various plant sources, has garnered attention for its potential to mitigate acne pathogenesis. In vitro and animal studies have highlighted PCA's ability to suppress pro-inflammatory cytokines (e.g., IL-6, IL-8) and enzymes (e.g., COX-2), thus alleviating inflammation associated with acne. PCA's antioxidant properties also contribute to reducing oxidative stress, which is implicated in acne development. Additionally, PCA exhibits antimicrobial effects against Propionibacterium acnes, offering a potential strategy to address the microbial aspect of acne.(6)(7)

Curcumin, a polyphenol derived from turmeric (Curcuma longa), is renowned for its multifaceted pharmacological activities. Its anti-inflammatory effects stem from inhibiting key inflammatory mediators and signalling pathways. Curcumin also modulates oxidative stress through its antioxidant capabilities, potentially aiding in mitigating acne-induced oxidative damage. Furthermore, curcumin exhibits antimicrobial properties against various pathogens, including Propionibacterium acnes, thereby targeting the microbial component of acne.(8)(9)

MATERIALS AND METHODS

Materials

Protocatechuic acid and curcumin. Other ingredients like carbapol-934, guar gum, xanthan gum, Methylparaben, propylparaben, Propylparaben and Glycerine.

Methodology (10)(11)

Preparation of gel:

PCA and Curcumin (1% w/w) was dissolved in a hot mixture containing propylene glycol (25% w/w) and glycerine (10% w/w) as moistening agent. The formulations of gel were prepared by dispersing weighed amount of polymers Carbopol 934, guar Gum, xanthan gum, guar gum and xanthan gum in water with constant stirring using magnetic stirrer at a moderate speed. Then, mixture containing drug was added. The pH of gel was adjusted using triethanolamine. Lastly, preservatives methyl and propylparaben were added slowly with continuous stirring. (12)

Table No.01: Formulation batches of Herbal gel containing PCA and Curcumin.

Ingredients	Formulation batch code							
	F1	F2	F3	F4	F5	F6	F7	F8
PCA	100mg	100mg	100mg	100mg	100mg	100mg	100mg	100mg
Curcumin	100mg	100mg	100mg	100mg	100mg	100mg	100mg	100mg
Carbapo-934	2g	-	-	2gm	1.5gm	2gm	-	2gm
Guar Gum	-	1gm	-	1gm	1gm	1gm	1gm	-
Xanthan Gum	-	-	5gm	1gm	1.5gm	-	2	2
Propylene Glycol	20ml	20ml	20ml	20ml	20ml	20ml	20ml	20ml
Glycerin	15ml	15ml	15ml	15ml	15ml	15ml	15ml	15ml
Methyl paraben	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm
Propyl paraben	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm	0.1gm
Distilled Water	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.

EVALUATION OF TOPICAL GEL (13)(14)

a. Physical Appearance:

The physical appearance, colour, and feel of the set herbal topical gel are visually tested.

b. Homogeneity:

All developed gels were tested for homogeneity by visual inspection after the gels have been set in the container. Gel was tested by usual for their appearance and presence of any aggregates.

c. Determination of pH:

The gel formulations, pH was determined by using digital pH meter. One gram of gel was dissolved in 100 ml of distilled water and stored for two hours. The measurement of pH of each formulation was done in triplicate and mean values were calculated.

d. Viscosity measurement:

The gel, viscosity was measured using Brookfield viscometer (model LVDVE, Engineering Laboratories, Middleboro, MA) spindle no 01 at 20 r.p.m. at temperature 4 °C and 37 °C. The procedure was carried out in triplicate.

e. Spreadability:

Spreadability was measured by a parallel plate process typically used to assess and measure the

spreadability of semi-solid preparations. One gram of gel was pressed between two horizontal plates of dimension 20× 20 cm, the upper of which weighed 125g. The spread diameter was measured after 1 min.

Spreadability was calculated using the following formula:

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

Where,
S= Spreadability,
M= Weight in the pan (tied to the upper slide),
L= Length moved by the glass slide, and
T=Time (in sec) taken to separate the slides completely

f. Skin irritation test:

Test for irritation of gel was performed on human volunteers. For each gel, five volunteers were selected and 1.0g of formulated gel was applied on an area of 2 square inch to the back of hand. The volunteers were observed for irritation or lesions.(15)

g. Drug content:

A specific quantity 100mg of developed gel and marketed gel were taken and dissolved in 100ml of phosphate buffer of pH 7.4. The volumetric flask containing gel solution was shaken for 2hr in order to get complete solubility of drug. This solution was filtered and estimated spectrophotometrically at 242 and 425nm using phosphate buffer pH 7.4 as blank.

h. *In Vitro* Diffusion Study:(16)

100 ml of pH 7.4 buffer solution was taken in 250 ml beaker. 5 ml of hair serum was taken into dialysis membrane and hung inside the beaker containing buffer solution. The content of beaker was rotated at 300 rpm with a magnetic bead at 37°C temp. 1 ml of sample was withdrawn at specified time interval with replenish of same volume of buffer solution. Conc. of drug was measured spectrophotometrically at 242 and 425 nm.

i. Stability Study:

For the evaluation of stability study, maintaining the formulations at an ambient condition over a period of three months on temperature 40^0C, 25^0C, and 37^0C. The pH, viscosity, and drug content were determined periodically.

RESULTS AND DISCUSSION

a. Physical Appearance:

It was observed that, the colour of the gel is look like was deep orange, which on the application were found to be smooth.

By visual examination of the appearance and presence of any lumps, flocculates, or aggregates, the produced herbal topical gel was checked for homogeneity. The homogeneity of prepared gel has been shown to be fine.

b. Homogeneity:

By visual examination of the prepared gel, appearance and presence of any lumps, flocculates, or aggregates, the produced gel was checked for homogeneity. The homogeneity of prepared serum has been shown to be fine.

c. Skin Irritation Test:

It is carried out by applying the serum on skin and tested for any redness or itching after 2 hours.

After 2hrs, it observed that there is no itching or redness on the part of skin where serum is applied. It is suggested that the hair serum was safe for the use.

Table no.02: Evaluation of Topical gel

Batch No	pH	Viscosity (Cps)	Homogeneity	Spreadability (g.cm/sec)
F1	6.4	4262	Good	6.89
F2	6.2	2032	Good	6.66
F3	7.1	3056	Good	5.40
F4	6.7	6078	Good	5.0
F5	6.9	5354	Good	5.5
F6	7.1	2745	Good	6.25
F7	6.5	3441	Good	5.88
F8	6.6	6092	Good	4.76

d. Drug content:

The data of drug content from all the prepared formulations showed that the values of PCA range between 78.66% and 98.70% and the values of curcumin ranges between 70.20% to 94.87%.

Table no.03: Drug content of Herbal gel

Batch No.	PCA	Curcumin
F1	98.70%	94.87%
F2	92.42%	80.20%
F3	88.63%	82.63%
F4	78.66%	70.25%
F5	81.77%	72.40%
F6	90.23%	87.32%
F7	93.45%	82.67%
F8	84.58%	76.65%

e. *In-Vitro* release study:

Cumulative percent drug released from all the batches were shown in the table 4 and 5. All the batches showed drug release of PCA and curcumin. Batch F1 showed 98.70% for PCA and 94.87% for curcumin respectively. Hence, Batch no F1 was selected as optimized. Batch no F1 have been selected for further studies like stability study.

Table no.04: Cumulative percent drug release of PCA

Time (hour)	PCA							
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
0	0	0	0	0	0	0	0	0
1	5.20	4.60	6.24	5.65	4.62	7.21	5.73	6.12
2	15.71	12.61	13.52	14.83	17.17	15.39	14.32	17.14
3	29.59	25.38	27.55	27.75	25.91	21.38	26.35	31.68
4	41.60	40.42	39.45	36.58	37.38	34.66	39.64	35.41
5	52.35	51.61	53.25	43.85	45.17	43.62	50.21	48.50
6	63.11	62.28	60.71	54.21	53.95	51.87	62.25	57.2
8	70.56	71.75	72.62	66.15	61.22	62.81	73.17	66.27
12	85.76	83.84	80.45	75.42	72.81	70.67	84.71	77.61
24	93.50	91.78	88.63	78.70	81.77	79.54	91.65	83.60

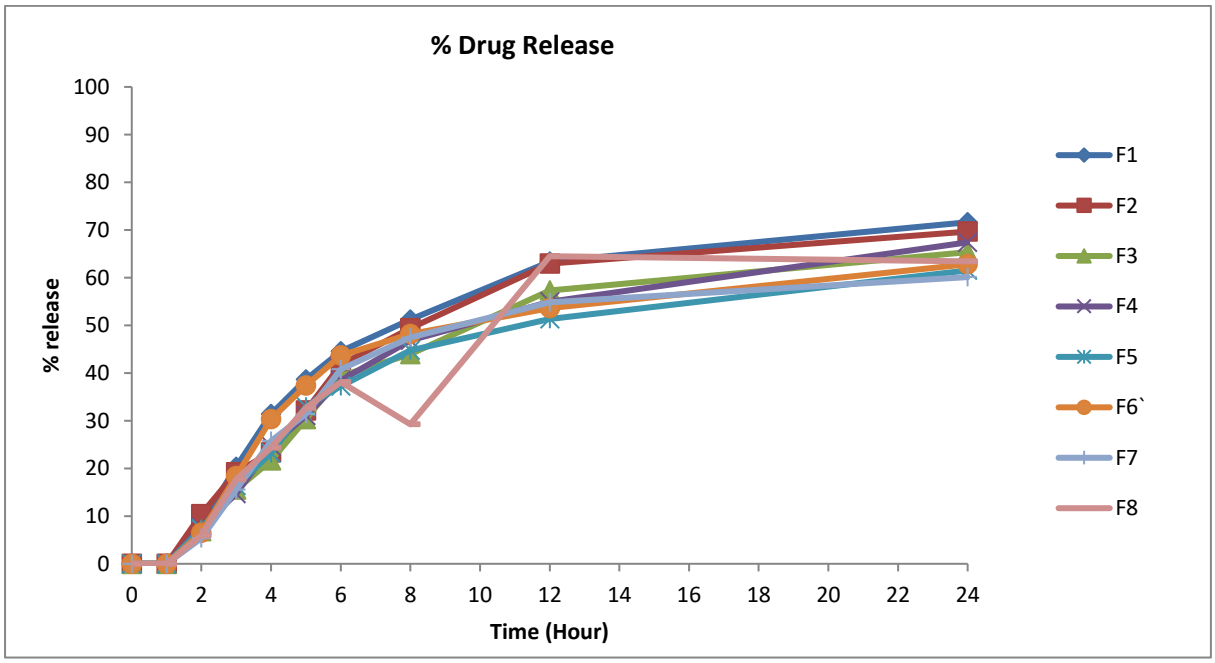

Fig.01: Cumulative percent drug release of PCA

Table no.05: Cumulative percent drug release of Curcumin

Time (hr)	Curcumin							
	F1	F2	F3	F4	F5	F6	F7	F8
0	0	0	0	0	0	0	0	0
1	8.45	10.41	6.85	7.61	7.27	6.48	5.38	5.96
2	20.31	19.17	15.55	14.69	16.37	18.39	15.54	17.68
3	31.40	23.34	21.67	24.71	23.20	30.33	25.77	24.38
4	38.65	32.17	30.34	31.09	32.92	37.40	31.38	32.70
5	44.56	41.72	39.40	38.48	37.25	43.70	40.80	38.12
6	51.22	49.42	43.97	46.82	44.76	48.20	47.45	29.26
8	63.37	62.92	57.31	54.97	51.31	53.63	54.85	64.50
12	71.62	69.66	65.35	67.41	61.52	62.81	60.12	63.43
24	80.21	78.29	72.35	75.85	68.63	79.52	68.20	73.62

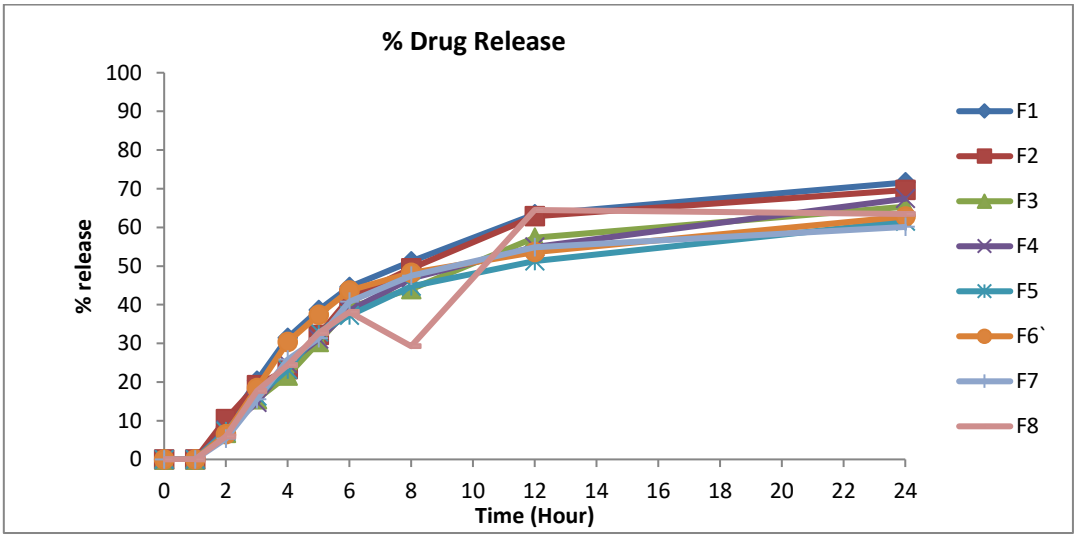

Fig.02: Cumulative percent drug release of Curcumin

f. Stability study:

For the evaluation of stability study, maintaining the formulations at an ambient condition over a period of three months on temperature 4^0C, 25^0C, and 37^0C. The pH, viscosity, and drug content were determined periodically.

Table no.06: Stability study of PCA and Curcumin

pH		Viscosity at 50 rpm (cps)		Drug content (%)			
				PCA		Curcumin	
Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	**Initial**	**Final**
6.4	**6.4**	**4262**	**4175**	**98.70**	**95.42**	**94.87**	**91.54**

Table 6 reveals that the herbal topical gel was stable during the research time, as gel showed no physical instability, and there was no noticeable difference in the pH, viscosity, and drug content before and after the study.

CONCLUSION

In the present study, an attempt has been done to prepare and evaluate Herbal topical gel containing PCA and Curcumin.

Topical route of application has a great potential as an effective and safe way to administer PCA and curcumin for local anti-inflammatory effect. The topical gel formulation of both the drugs developed in this study has great utility and controlled management of inflammation.

Topical gels offer a versatile approach to addressing various skin concerns or delivering therapeutic agents. Topical gels allow for targeted treatment directly on the affected areas. This helps concentrate the active ingredients where they are needed most

and reduces the risk of affecting healthy skin. Protocatechuic acid and curcumin are anti-inflammatory and antioxidant properties can contribute to strengthening the skin's natural barrier function, which is important for maintaining hydration and protecting against external stressors.

PCA and Curcumin Herbal Topical gel were prepared and evaluated for physical appearance, pH, homogeneity, spreadability, skin irritation test, viscosity, Drug content, In-vitro release study and stability study. Based on this parameter, all the formulations showed satisfactory results. Among the eight formulations formulation F1 showed good results than other formulations.

Batch F1 showed good in vitro drug release and shown good result for all parameters when compared with all other formulations. Hence Batch F1 Further stability of selected formulation had been done on different temperature such as on 4°c, 25°c and 37°c for 3 months. There were no significant changes in the viscosity, and physical appearance of the gel after storing at different temperature conditions for three months.

In conclusion, the preparation and evaluation of the Polyherbal gel develop in this study have great utility and are a viable option for effective and controlled management of inflammation.

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