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RESEARCH ARTICLE

Formulation and comparative evaluation of poly herbal anti-acne face wash gels

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Abstract

Context: Rauvolfia serpentina (L). Benth. ex Kurz. (Apocynaceae) possessing antibacterial properties are widely used in modern herbal medicines. *Curcuma longa* L. (Zingiberaceae), a readily available antiseptic, possess antioxidant, antibacterial, blood purifying and antiinflammatory properties and used in various skin creams. *Azadirachta indica* A. Juss. (Meliaceae) possess astringent, antiviral, discutient, stimulant and antibacterial properties and works excellently well against acne and keeps the skin healthy.

Objective: Acne is the common skin problem that 85% of the teenagers face today. In this study, poly herbal anti-acne face wash gels were prepared using two polymers Carbopol and hydroxy propyl methyl cellulose (HPMC) along with the extracts of plants *Rawvolfia serpentina, Curcuma longa*, and *Azadiracta indica.*

Materials and methods: The gel formulations were prepared in four different concentrations of 50, 100, 200 mg/ml as Gel-CRB 100, Gel-HPMC 50, Gel-HPMC 100, Gel-HPMC 200, respectively. The formulations were tested for the anti-acne activity by turbidimetric method.

Results: Results showed that the gels were non-irritant, stable and posses anti-acne activity. The efficacy when tested with a standard was almost same to that of Clindamycin gel.

Discussion and conclusion: From this study, Gel-HPMC 100 was proved to be stable and considered as an effective herbal formulation for acne treatment.

Keywords: Acne, carbopol, HPMC, anti-acne activity, turbidimetric method

Introduction

The herbal drug industry in India is probably the oldest medical care system in the world. The history of herbs in ancient India is so old that the ancient form of herbal healing has even been mentioned in the Vedas, an ancient religious work of the Indians. The ancient herbal healing methods of Ayurveda and Unani deal with the use of herbs and natural products to tackle health conditions. Although herbal medicines would appear to be new for western healers and medical practitioners, the truth is that most prescribed medicines even today contain plant extracts. At present, the countries across the world appreciate this ancient form of medicine and Indian herbal drugs are in good demand resulting in its rapid growth and witnessing almost a thirty percent growth rate annually (Rashmi, 2008). A great increase in the worldwide demand for herbal cures, herbal skin care products and even herbal cosmetics were observed in the recent years.

Skin, being the most exposed part of our body to the pathogens, require protection from skin diseases, especially acne causing bacteria. Acnes are found to be the most common skin problem that 85% of the teenagers face today. They may continue to even adulthood and mostly affect the areas with largest oil glands like face and neck. Acnes are generally characterized by the presence of seborrhea, inflammatory lesions, comedone, excessive sebum production and host to bacteria such

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as *Propionibacterium acnes, Staphylococcus epidermidis,* and *Malassezia furfur* in the follicles. So these microorganisms can be targeted for the potential acne treatment.

The usage of the long-term antibiotics for the treatment makes the organisms develop resistance to the drugs. This adaptation is multi-factorial and depends upon the organism susceptibility to the treatment and host factors like hormones, stress conditions etc. To overcome this problem, the herbal alternatives for the treatment have been studied. As the herbal extracts cannot be directly used for the treatment, they were modulated and were formulated as poly herbal anti-acne face wash gel. In this study, the gels were formulated using hydroxy propyl methyl cellulose (HPMC) and Carbopol with varying concentrations of the herbal extracts and were tested for their anti-acne efficacy and were examined for the antimicrobial activity against the acne causing microorganisms.

Materials and methods

Plant material

The plant materials used in the formulation were collected from the whole sale supplier of Herbal Crude Drugs, Mumbai, India. These were authenticated by Dr. Madhava Chetty, Associate Professor, Department of Botany, S.V. University, Tirupati, India and a specimen was kept in the Herbal Herbarium, Sree Vidyanikethan College of Pharmacy, Tirupati, India.

Animals and media

Wistar albino rats (150–200 g) of four groups, including control and standard group, each with three animals were selected. Nutrient broth and agar media were obtained from the SD Fine Chemical Ltd, Mumbai, India. The selected animals were housed in acrylic cages at standard environmental conditions at 25 ± 2°C, relative humidity of 45–55%, in a well ventilated room maintained at 12:12 h light:dark cycle, fed with standard rodent diet and water *ad libitum*. All the animals were acclimatized for a week before experiment. The animal experiments were carried out according to the guidelines of the Committee for the Purpose of Control of Experiments on Animals (Reg. No. 930/a/06/CPCSEA) and approval of the Institutional Animal Ethics Committee, Sree Vidyanikethan College of Pharmacy, Tirupati, India was obtained.

Preparation of crude extract

The dried roots of *Rauwolfia serpentine* (L). Benth. ex Kurz. (Apocynaceae) (12.5% w/w), dried rhizomes of *Curcuma longa* L. (Zingiberaceae) (15% w/w), and dried leaves of *Azadiracta indica* A. Juss. (Meliaceae) (13.5% w/w) material were finely ground and separately passed through sieve no. 80. Each powder (500 g) was macerated for 3 days with 95% ethanol and filtered. The filtrates were dried using a vacuum desiccator. Each extract (45 g) was dissolved in 150 ml of ethanol (300 mg/ml). This was concentrated to a final volume of 135 ml and was considered as stock solution A.

Formulation of gel base

All ingredients were weighed and are given in Table 1. Gels were formulated using HPMC and Carbopol 940 (Harisaranraj et al., 2010) and termed as Gel-HPMC and Gel-CRB. The geling agents were dispersed in a small quantity of distilled water with stirring and glycerin was added slowly. The powder ingredients were dissolved in remaining amount of water and left for stirring over night (Gowda et al., 2009).

Formulating anti-acne face wash gel

The stock solution A (30 ml) was dissolved in 100 ml of gel-CRB and stirred for 2 h. This was named as Gel-CRB 100. Similarly three formulations, Gel-HPMC 50, Gel-HPMC 100, and Gel-HPMC 200 were prepared by dissolving 15, 30, and 60 ml of stock solution A, each in 100 ml of Gel-HPMC which yields an extract concentration of 300, 150, 300, and 600 mg/ml, respectively.

Comparative evaluation of prepared gels

The physical properties were determined. Viscosity was measured using the Brook Field Viscometer (Ottendorf, Germany) (Hiremath et al., 2008) and pH of gels was measured using digital pH meter (New Delhi, India). Gel (1 g) was dissolved in 100 ml of distilled water for measuring pH. Spreadability was determined as per the procedure explained in the literature (Panigrahi et al., 2006; Gowda et al., 2009). The stability of the gels was tested using freeze thaw cycling method. The gels were subjected to a temperature of 4°C for 7 days, 25°C for 7 days and then at 40°C for 7 days (Schoch, 1968). The gels were exposed to the ambient room tempera-

Table 1. Ingredients used in the formulation.

Gel-HPMC		Gel-CRB	
Ingredient	Quantity	Ingredient	Quantity
HPMC (hydroxy propyl methyl cellulose)	3.0 g	Carbopol 940	500 mg
Glycerin	50 ml	Glycerin	50 ml
Lauric acid	10 mg	Lauric acid	10 mg
Triethanolamine	1.0 ml	Triethanolamine	1.0 ml
Methyl paraben	0.5 mg	Methyl paraben	0.5 mg
Propyl paraben	0.5 mg	Propyl paraben	0.5 mg
Distilled water	20 ml	Distilled water	20 ml

Table 2. pH, viscosity and spreadability of formulations.

Formulation	pH*	Viscosity*(cps)	Spreadability* (g·cm/s)
Gel-CRB 100	6.46 ± 0.04	8266 ± 0.11	3.1 ± 0.31
Gel-HPMC 50	6.82 ± 0.49	8742 ± 0.28	3.4 ± 0.14
Gel-HPMC 100	7.22 ± 0.37	7548 ± 0.34	2.2 ± 0.50
Gel-HPMC 200	7.34 ± 0.12	5164 ± 0.45	1.9 ± 0.33

*Mean of triplicate readings.

Table 3. Stability studies of formulations.

	pH			Viscosity (cps)			Synerisis		
Formulation	4°C	25°C	40°C	4°C	25°C	40°C	4°C	25°C	40°C
Gel-CRB 100	6.45	6.46	6.46	8265	8266	8266	No	No	No
Gel-HPMC 50	6.82	6.82	6.82	8740	8742	8747	No	No	No
Gel-HPMC 100	7.22	7.22	7.22	7548	7548	7550	No	No	No
Gel-HPMC 200	7.34	7.34	7.36	5163	5164	5164	No	No	No

ture after each step and noted for synerisis, viscosity, and pH changes.

The skin irritation test was performed on albino rats of both sex weighing about 150–200 g. The animals were maintained on standard animal feed and free access to water. Hair was shaved from the back of the rats and an area of 2 cm^2 on both sides. One side served for control (5% sodium lauryl sulfate in distilled water) and the other side for test with two animals for each formulation (Hiremath et al., 2008). Gels were applied twice a day for 3 days and the site was observed for any sensitivity, edema, and erythema.

Determination of antimicrobial activity of poly herbal anti-acne face wash gels against acne causing microorganisms

Turbidimetric method was used for the screening of antimicrobial activity. A sterile nutrient agar medium was prepared and spread on a Petri plate aseptically. The skin on the face of a volunteer with distinctive acnes was washed with distilled water and let to dry. Then a cotton swab was rubbed on the ruptured pimple till its entire surface touched the acne and it was soaked in 5 ml of distilled water. This solution was evenly poured on to the previously prepared medium. This was incubated for 24 h at 37°C to get a good culture of microorganisms (Mondal, 2004).

Six sterile cotton balls of 1 cm diameter were soaked in prepared formulations standard drug and distilled water for 5 min. Nutrient broth (50 ml) was prepared and sterilized; 5 ml was kept aside and was used as reference standard in one cell of the UV spectrophotometer. The remaining broth was inoculated with the organism cultured in the Petri plate. This inoculated broth (5 ml) was poured into six sterile test tubes and the cotton balls were suspended in each of the test tube and marked accordingly. They were incubated for 24 h at 37°C in an incubator. Then they were taken out and checked for the absorbance at 600 nm.

Results and discussion

The color of the formulations was brownish yellow and the intensity of the color increased with the increase in concentration of the extract in the gel. This might be due to the brownish yellow color of the combined extracts. The viscosity and the pH of the formulations are given in Table 2. The results showed that pH and viscosity were significantly changed as the concentration of extract increased. The pH value of the products varied from 6.82 to 7.34. Exceptionally Gel-CRB 100 showed a pH of 6.46. This might be due to the acidic nature of Carbopol used in the formulation. This shows the weak acidic nature of the anti-acne gels. The viscosity values showed a consistent decrease with the increase in the concentration of extract. The viscosity of the Gel-CRB 100 was between Gel-HPMC 50 and 100. This shows that the Carbopol in even lesser quantity give a good consistency to the gel. The results of the spreadability test was given in Table 2 and observed that Gel-HPMC 50 with 3.4 g·cm/s possess a better spreadability than other formulations.

Table 4. Anti-acne efficacy of formulations.

Formulation	Absorbance*
Gel-CRB 100[a]	0.1438 ± 0.02
Gel-HPMC 50[a]	0.166 ± 0.07
Gel-HPMC 100[a]	0.1432 ± 0.01
Gel-HPMC 200[a]	0.1285 ± 0.03
Standard[b]	0.1271 ± 0.04
Control	0.759 ± 0.03

*Mean of triplicate readings.
[a]10% extract in distilled water. [b]Concentration of clindamycin (100 mg/ml).

Stability studies were performed and the results were tabulated in Table 3. The results showed that the gels stood stable at all temperatures with a little change. The pH was slightly increased for Gel-HPMC 200 at 40°C. The viscosity of the formulations varied and the Gel-CRB 100 showed a decrease of 1 cps at 4°C, Gel-HPMC 50 showed a variation of 7 cps between 4 and 40°C, Gel-HPMC 100 showed a raise of 2 cps at 40°C and Gel-HPMC 200 showed a decrease of 1 cps at 4°C. No syneresis was exhibited by the gels. Thus, it can be concluded that all formulations are exhibiting similar stability profiles.

The skin irritation test performed showed no signs of sensitivity, erythema, and edema. So the prepared formulations were considered to be non-irritant. The efficacy of the anti-acne gels from herbal extracts is shown in Table 4. The anti-acne gels could inhibit the growth of the microorganisms that inhabit acnes and all the formulations exhibited comparatively less efficacy to standard drug but Gel-HPMC 200 showed almost equal absorbance to Clindamycin gel. Gel-CRB 100 showed high absorbance compared to Gel-HPMC 100 indicating high growth of microorganisms even the extract concentration is same. Hence, HPMC is considered best for preparation of anti-acne gels. The comparison of the gels with the standard and control is shown in Figure 1.

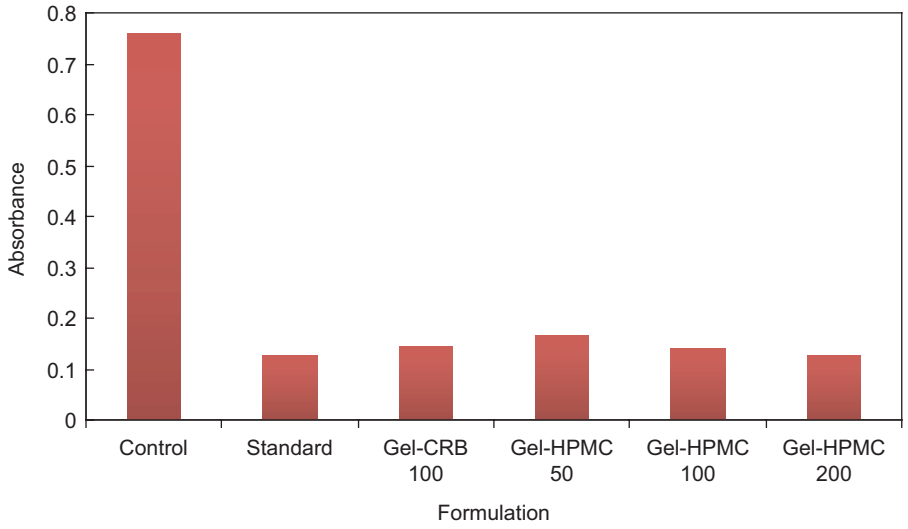

Figure 1. Anti-acne efficacy of formulations.

Conclusion

This study aimed at developing poly herbal gels for anti-acne treatment using extracts of *Rawvolfia serpentina, Curcuma longa* and *Azadiracta indica* in an aqueous based Carbopol and HPMC gel system. Four formulations of the gel were prepared by varying the proportions of polymers and evaluated for their physicochemical properties, like pH, spreadability, viscosity, and microbial assay. Based on these tests, formulation Gel-HPMC 100 containing Carbopol 940 was selected as the best formulation. The microbial assay of all the formulations demonstrated better inhibitory activity against *Propionibacterium acnes, Staphylococcus epidermidis*, and *Malassezia furfur* and stood competitive to the standard marketed formulation. It was concluded that the present research might hopefully bring advancement in the treatment of acnes using herbs as well as in developing poly herbal formulations for safe and effective management of diseases.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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