



FORMULATION AND EVALUATION OF POLYHERBAL GEL FOR SKIN CLEANSING, ANTI-ACNE AND NOURISHING

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ABSTRACT

The skin, being the largest organ of the body, plays a crucial role in protecting against external aggressors and maintaining bodily functions such as thermoregulation and hydration. Common skin issues like dryness, roughness, and acne are often attributed to factors like bacterial overgrowth and inflammation. To address these concerns, herbal remedies such as neem, aloe vera, turmeric, and lemon extracts have gained prominence due to their perceived efficacy and minimal side effects compared to synthetic alternatives. This study aimed to formulate and evaluate a polyherbal gel containing extracts from Neem (*Azadirachta indica*), Turmeric (*Curcuma longa*), Aloe (Aloe vera), and Lemon (*Citrus limon*) for their cleansing, anti-acne, and skin nourishing properties. These botanicals are renowned for their antimicrobial, anti-inflammatory, and antioxidant activities, making them ideal candidates for skincare formulations. The gel formulation was prepared using Carbopol-934 as a gelling agent, with polyethylene glycol serving as a co-solvent and propyl-paraben as a preservative. Various parameters such as color, appearance, consistency, pH, spreadability, and skin irritation were evaluated and compared with marketed formulations. Results indicated that the polyherbal gel exhibited promising activities across all assessed parameters, demonstrating its potential as an effective skincare product. Its wide spectrum of antioxidant activity particularly targeted acne-prone skin, offering a holistic approach to skin health. In conclusion, the formulated gel comprising turmeric, lemon, neem, and aloe vera extracts showcased favorable properties for skin cleansing, acne treatment, and nourishment. This study underscores the growing demand for herbal formulations in the global market and highlights the therapeutic potential of natural remedies in skincare.

KEYWORDS: Turmeric extract, Lemon extract, Neem juice, Aloe vera juice, Carbopol-934, Anti-Acne, Antioxidant activity.

INTRODUCTION

1.1 Aim

This project aims to design a pharmaceutical gel dosage form, specifically focusing on the "Formulation and Evaluation of Polyherbal Gel." The intended gel formulation possesses antioxidant activity, serving as an anti-acne medication by combatting free radicals on the skin.

1.2 Objectives

The project work encompasses the following objectives:

- Characterization of polyherbal gel.
- Formulation and evaluation of the polyherbal gel, incorporating antioxidant activity through gelling agents and other essential ingredients.

The defense against oxidative stress is a crucial aspect of skin health, making antioxidant-rich formulations particularly beneficial. Gel formulations are favored due

to their cost-effectiveness, ease of production, and suitability for topical application.

1.3 Background and Purpose of the Project

There's a growing demand for herbal formulations in the global market, driven by their reported antimicrobial, antioxidant, refreshing, moisturizing, and cleansing properties. Additionally, herbal extracts contribute to skin rejuvenation, blemish reduction, and acne treatment, promoting a flawless complexion.

The active compounds present in the plant extracts, such as vitamin C, confer antioxidant properties essential for skin health. The herbal gel formulation, derived from both aqueous and alcoholic extractions, aims to address common skin issues like dryness, roughness, and acne, particularly during hormonal changes like puberty.

Herbal remedies like neem, aloe vera, turmeric, and lemon are incorporated into the gel formulation to

combat bacterial overgrowth and inflammation, common factors in acne pathogenesis. By harnessing the benefits of these natural ingredients, the project seeks to offer a holistic solution for maintaining healthy, clear, and radiant skin.

MATERIALS AND METHODS

Given formulation is developing with different herbal extracts as well as with the help of some synthetic ingredients which has necessarily use in the formulation of gel preparation.

Table No. 1: List of herbal ingredients.

Sr. No	Herbal Ingredients	Activity
1.	Neem leaves (<i>Azadirachta indica</i>) meliaceae.	Antioxidant, anti-fungal
2.	Aloe vera leaves (<i>Aloe barbadensis</i>) liliaceae.	Moisturizing agent
3.	Turmeric rhizomes (<i>Curcuma zingiberaceae longa</i>)	Antioxidant
4.	Lemon peel (<i>Citrus limon</i>) Rutaceae.	Antioxidant
5.	Rose water	Mask to the odour

Collection and preparation of extracts

1. Neem Leaves

Collection: Leaves of Neem (*Azadirachta indica*) belonging to the Meliaceae family are collected from the tree. Neem is a flowering plant that typically starts fruiting after 3 to 4 years. **Washing:** The collected leaves are washed thrice with cold water to remove any dirt or impurities.

Soaking: The washed leaves are soaked overnight (12 hours) in water. The ratio of water to leaves is 1 liter per 1 kg of leaves.

2. Aloe Vera Leaves

Collection: Leaves of Aloe vera are collected and washed.

Juice Extraction: Fresh juice is extracted from the Aloe vera leaves.

Preservation: The fresh juice is stored in a container with 0.1 amount of glycerin to maintain its viscosity and moisturizing properties.

3. Turmeric Rhizomes

Collection: Rhizomes of Turmeric (*Curcuma longa*, Zingiberaceae) are collected.

Drying: The collected rhizomes are dried in a hot air oven at a temperature of 50°C.

Powdering: Once dried, the rhizomes are powdered.

Extraction: The powdered rhizomes are further extracted using a Soxhlet apparatus. Methanolic extract is collected.

Evaporation: The methanolic extract is evaporated using an electronic water bath. Filtrates are allowed to evaporate in an evaporating pan at a temperature of 60°C until the desired concentration of the extract is obtained.

4. Lemon Peel Juice Preparation

Collect lemon peels from lemon fruits.

Extract the juice from the lemon peels.

All obtained fresh extracts are used in the formulation of polyherbal gel.

Ingredients other than active herbal extracts These are the ingredients which has the different properties to formulating gel other than active extracts. Example; thickening agents, gelling agents etc.

Table No. 2: List of ingredients other than active herbal extracts.

Ingredient	Role
Carbopol-940	Gelling agent
Propyl Paraben	Preservative
EDTA	Chelating agent
Triethanolamine	Neutralizer
PEG-400	Gelling Base
Cellulose [CMC]	Thickening agent

Based on the provided information, here's the composition of the polyherbal gel formulation along with the method of preparation:

Table No. 3: List of synthetic ingredients for formulation (20 gm.)

Ingredient	Quantity Sufficient	Role
Carbopol-940	0.3 gm	Gelling agent
Propyl Paraben	0.2gm	Preservative
EDTA	0.2 gm	Chelating agent
Triethanolamine	0.010 gm	Nutrilizer
PEG-400	0.5 gm	Gelling Base
Cellulose [CMC]	0.4 gm	Thickning agent

Excipient profile**Table No. 4: Excipient profile.**

Name	Nonproprietary name	Structural formula	Uses
Carbopol	BP-carbomers PhEur-carbomer USP-NF-carbomer		Gelling agent (0.5-2.0)
PEG	BP-Macrogol JP-macrogol 400		Plasticizer, solvent

Composition of polyherbal gel formulation

Here is the table given for the all four formulations with

their ingredients as well as quantity of ingredients with active herbal extracts.

Table No. 5: For composition of 20 gm. of Gel formulation.

Sr no.	Name of ingredients	Quantity taken				Role
		F1	F2	F3	F4	
1	Neem extract (gm)	1	1.5	1	1.5	Antibacterial
2	Turmeric extract(gm)	1	1.5	1	1.5	Antioxidant
3	Aloe vera extract(gm)	1	1.5	1	1.5	Moisturizing Agent
4	Lemon extract(gm)	1	1.5	1	1.5	Antioxidant
5	Carbopol -940(gm)	1	1.5	1	1.5	Gelling agent
6	Propyl paraben(gm)	1	1	1	1	Preservative
7	EDTA (gm)	0.2	0.2	0.2	0.2	Chelating agent
8	Triethanolamine (gm)	0.10	0.20	0.10	0.20	Neutralizer
9	Carboxymethyl cellulose (CMC) (gm)	1	1.5	1	1.5	Thickening agent
10	Polyethylene glycol (PEG)- 400 (gm)	2.50	2.50	2.50	2.50	Gelling base
11	Distilled water (Q.s)	100 (q.s)	100 (q.s)	100 (q.s)	100 (q.s)	Diluent
12	Rose water (Q.s)	0.7	0.7	0.7	0.7	Flavourant

Method of Preparation

1. Disperse 1g of Carbopol 940 in 50ml of distilled water. Set aside to allow Carbopol 940 to swell and form a gel.
2. Dissolve required quantity of Propyl Paraben in 5ml of distilled water by heating on a water bath. Allow the solution to cool.
3. Add Propylene Glycol 400 and Carboxymethyl Cellulose (CMC) to the above solution.
4. Mix the required quantity of active herbal extracts into the above mixture.
5. Slowly add this solution into the Carbopol 940 gel with continuous stirring.
6. Add Triethanolamine dropwise to the formulation to adjust the required skin pH and achieve the desired gel consistency.

Evaluation parameters of gel formulation**a) Visual Inspection**

Color: Check if the gel has the desired color (pale yellow/yellow in this case).

Clarity: Ensure the gel is clear and free from any particulate matter or cloudiness.

Homogeneity: Look for uniformity in texture throughout the gel.

Odor: Assess if there are any undesirable odors present.

b) Appearance

Confirm that the appearance matches expectations based on the intended formulation.

c) Consistency

Apply the gel on the skin and assess its consistency. It should spread evenly and have the desired texture.

d) Greasiness

Apply the gel onto the skin and a slide to determine if it feels greasy. It should ideally absorb well into the skin without leaving a greasy residue.

e) pH Determination

Use a digital pH meter or pH paper to measure the pH of the gel. Ensure it falls within the desired range for skin compatibility and stability.

f) Viscosity Determination

Use a viscometer to measure the viscosity of the gel. Note the corresponding dial reading on the meter at a specified speed and temperature (60 rpm at 25°C in this case). The viscosity should match the desired consistency for the intended application.

To determine the spreadability using the given formula:

$$S = \frac{M \cdot L}{T}$$

Where:

- S is the spreadability in grams per centimeter per second (g/cm/sec)
- M is the mass in grams (g)
- L is the distance covered by the top slide in centimeters (cm)
- T is the time in seconds (sec)

You've mentioned that the distance covered by the top slide is 7.5 cm.

Let's say M is the total mass applied, which includes the mass of the gel (2g) and the additional weight (100g). So, $M = 2g + 100g = 102g$.

Given that $L = 7.5$ cm and T is the time in seconds taken for the top slide to cover this distance, which is measured in the experiment, let's say $T = t$ seconds.

Substituting these values into the formula, we get:

$$S = \frac{102g \times 7.5cm}{t}$$

So, to determine the spreadability, you need to measure the time taken (in seconds) for the top slide to cover a distance of 7.5 cm. Then plug that value into the formula along with the mass of the system (102g) and calculate the spreadability in grams per centimeter per second.

g) Determination of Extrudability

This test assesses how easily the gel can be extruded from its container, which is important for practical application. It involves applying pressure to a tube filled with the gel and measuring the amount extruded through a specific opening size.

h) Solubility

The gel's solubility in different solvents (ethanol, methanol, chloroform, and water) is tested to understand its dissolution characteristics. This helps in determining its compatibility and stability in various environments.

i) Clarity

Clarity evaluation involves observing the appearance of the gel formulation in a glass container. This test assesses the transparency or opaqueness of the gel, which can influence its aesthetic appeal and user experience.

j) Washability

Washability testing determines how easily the gel can be removed from the skin or other surfaces when washed with water. This is important for assessing its ease of use and potential for residue or build-up.

k) Irritancy Test (Patch Test)

Patch testing is performed to evaluate the potential of the gel formulation to cause skin irritation or allergic reactions. Small amounts of the gel are applied to the skin of volunteers, typically on the forearm, and observed for any adverse reactions such as redness, swelling, or itching.

DPPH assay for evaluating the antioxidant activity of gel

An inter-laboratory evaluation study was conducted in order to evaluate the antioxidant capacity of gel using a 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay. These showed that the proposed DPPH assay could be used as a

standard method to evaluate the antioxidant capacity of the gel.

In this study, the DPPH assay was conducted according to the following procedure.

The methods for preparing each reagent were detailed in the analytical procedures.

1) Preparing DPPH Solution

Weigh 7.8 mg of DPPH using a chemical balance.

Dissolve the weighed DPPH in 99.5% ethanol to make a 0.2 mM DPPH solution.

Fill a 100 mL measuring flask or cylinder with a stopper to obtain a constant volume.

Keep the DPPH solution in the dark for 2 hours until the absorbance stabilizes.

After stabilization, transfer 1 mL of the DPPH solution into a test tube.

Add 200 μ L of ethanol and 800 μ L of 0.1 M sodium phosphate buffer (pH 7.4) into the test tube.

Mix the solution and measure the absorbance at 517 nm. Use a mixed solution of ethanol and sodium phosphate buffer as a blank.

2) Preparing Sodium Phosphate Buffer (pH 7.4) Mix 40 mL of 0.2 mol/litre sodium hydroxide with 50 mL of 0.02 mol/litre sodium hydrogen phosphate. Dilute the mixture to 100 mL.

3) DPPH Assay Procedure

Add 200 μ L of the analytical sample solution and 800 μ L of 0.1 M sodium phosphate buffer (pH 7.6) into a test tube.

Add 1 mL of the prepared DPPH solution immediately.

Mix the solution with a test tube mixer for 10 seconds and leave it at room temperature in the dark.

After exactly 30 minutes, measure the absorbance of the solution at 517 nm.

Use a mixed solution of ethanol and sodium phosphate buffer as a blank.

4) Calculating Inhibition Ratio

Calculate the inhibition ratio (%) using the equation: Inhibition ratio (%) = $\{(A_c - A_s) / A_c\} \times 100$ where A_c is the absorbance at the addition of ethanol (blank) and A_s is the absorbance at the addition of the analytical sample.

5) Analytical Procedure

Perform measurements at six points of concentration, including a control.

Repeat the measurements of DPPH radical scavenging activity for the analytical sample solution at each concentration three times.

RESULTS

The results of the evaluation of the polyherbal gel formulation are summarized below:

- **Results are given below in the table.**

As we performed all evaluation parameters tests, the results are also found for every single tests of the gel formulation. Evaluation of polyherbal gel has been

performed with parameters given for the evaluation purpose of the gel. It is evaluated by all factors like physiochemical as well as physiological factors.

Table No. 6: Physicochemical characteristics of gel.

Sr. No	Parameters	Observation
1	Colour	Yellow
2	Odour	Aromatic
3	Acid value	2.60
4	Ester value	37.20
5	Solubility in ethanol	Freely soluble
6	Density	1.02g/ml
7	Refractive index	1.48

Table No. 7: Some Basic Parameters Like; pH, appearance, Spreadability, Extrudability, Homogeneity as well measured as per IP.

Formulation	Appearance	pH	Spreadability	Extrudability %	Homogeneity	Drug Content
F1	Pale yellow	5.5	18.20	92.13	Good	78.8
F2	Yellow	4.9	18.16	93.12	Good	68.34
F3	Yellow	5.0	17.47	94.14	Very good	79.81
F4	Yellow	4.4	17.45	90.23	Very good	69.78

Table No. 8: Inhibition ratio (%) of antioxidant activity determination by DPPH assay.

Sr. No.	Concentration (ml)	Absorbance of sample (As)	Absorbance of control (Ac)	Inhibition ratio (%)
1	0.2 ml	1.2	1.67	29.37%
2	0.4 ml	1.19	1.72	30.81%
3	0.6 ml	0.92	1.66	44.57%
4	0.8 ml	1.0	1.67	40.11%
5	1.0 ml	1.0	1.72	41.86%

Table No. 9: Determination of antioxidant activity of gel.

Sr. No.	Antioxidant activity
10-20%	Poor
20-40%	Fair
40-60%	Good
60-80%	Very Good
80%<	Excellent

Antioxidant activity found- as per the results inhibition ratio of the sample of gel formulation having good (40-60 %) antioxidant activity.

- **Result of activity determination**

As we have performed DPPH assay procedure for the determination of antioxidant activity of the gel. By performing this procedure absorbance was recorded for the sample as well as control group.

Table No. 10: Stability testing of formulation of polyherbal gel.

Sr. No	Duration parameters	Storage conditions					
		7 days		15 days		30 days	
		8°C	40°C	8°C	40°C	8°C	40°C
1	Appearance	semisolid	semisolid	semisolid	Semisolid	Semisolid	Semisolid
2	Colour	yellow	Yellow	yellow	Yellow	Yellow	Yellow
3	Odour	Aromatic	Aromatic	Aromatic	Aromatic	Aromatic	Aromatic

As per the results are shown in Table no.10, formulation showed no significant changes in appearance, odour, and colour after 30 days. The gel has good stability.

DISCUSSION

1. Characterization of Lemon Oil and Turmeric Extract: The parameters such as acid value, density, and refractive index provide important insights into the chemical composition and purity of the procured lemon

oil. Similar characterization would be beneficial for the turmeric extract to ensure consistency and quality in the formulations.

The procured lemon oil was characterized for the following parameters Acid value-2.601 Density-1.02gm/ml Refractive index-1.48

2. Formulation Development: The use of lemon oil and turmeric extract in varying concentrations along with carbopol for gel formulation is a strategic choice, considering their known antioxidant and cosmetic properties. However, the rationale behind selecting specific concentrations of these ingredients could be elaborated further.

3. Physicochemical Properties of Formulations: The discussion on pH, spreadability, homogeneity, glossiness, and tube extrudability provides a comprehensive overview of the physical characteristics of the developed gel formulations. It would be interesting to delve deeper into how these properties influence the overall performance and user experience of the formulations.

4. Drug Content and Stability: The determination of drug content and stability under different storage conditions is crucial for assessing the quality and shelf-life of the formulations. Further insights into the analytical methods employed for these assessments and their validation would strengthen the study.

5. Antioxidant Activity: The use of DPPH assay to evaluate the antioxidant activity of the formulations is noteworthy. However, it would be beneficial to discuss the specific mechanisms through which lemon oil, turmeric extract, and other plant constituents contribute to antioxidant activity and how this translates into potential therapeutic benefits for skin health.

6. Safety and Efficacy: The absence of irritation and greasiness observed in patch tests and washability tests is promising for the safety and user acceptability of the formulations. Further discussion on the safety profile of individual ingredients, potential interactions, and long-term effects on skin health would be valuable.

7. Comparative Analysis and Future Directions: The literature survey suggests that formulations containing plant extracts exhibit enhanced antioxidant activity compared to those without. A comparative analysis of different formulations and their efficacy in delivering active ingredients to the skin could provide valuable insights for future research and product development.

8. Regulatory Considerations: Compliance with regulatory guidelines and standards for cosmetic products, such as ICH stability testing, is essential for ensuring product safety and efficacy. Discussion on

regulatory requirements and how the study adheres to these guidelines would be informative.

CONCLUSIONS

The results of the studies conducted on the polyherbal gel formulation, comprising ethanolic extracts of *Azadirachta indica* (neem), *Curcuma longa* (turmeric), *Aloe barbadensis* (aloe vera), and *Citrus sativum* (lemon) in various concentrations, demonstrated no skin irritation following patch tests. Furthermore, physical analysis and stability studies indicated the efficacy and stability of the prepared polyherbal gel. Consequently, this formulation can be deemed safe for application on human skin. The observed effectiveness of the polyherbal formulation may be attributed to the synergistic action of the plant constituents present in the formulation, particularly at a concentration of 0.6 mL, which exhibited notable antioxidant activity.

The herbal extracts used in the formulation are known for their antioxidant properties, primarily due to the presence of active compounds such as vitamin C. The composition of the herbal gel includes extracts obtained through both aqueous and alcoholic extraction methods. Maintaining healthy and clear skin requires balanced nutrition, and hormonal changes during puberty often lead to various skin issues such as dryness, roughness, and pimples, primarily attributed to bacterial overgrowth and inflammation.

To address these common skin problems, the formulation incorporates herbal remedies like neem, aloe vera, turmeric, and lemon. These ingredients are chosen for their known benefits in promoting skin health and combating bacterial overgrowth and inflammation. Overall, the formulated polyherbal gel presents a promising solution for maintaining clear, healthy, and glossy skin, leveraging the combined benefits of these natural ingredients.

REFERENCES

1. www.ejpmr.com
2. We thank our Principal Dr. S.L. Jadhav, Dr. D.D.Gaikwad, Mr. D.K.Gunjal, Mr. S.B. Pingle Sir, Mr. P.K. Dhawade, Mr. P.S. Rahinj and 2. Dr Kokate, P Purohit, S. B. Gokhale, Pharmacognosy Text Book, Nirali Publication.
3. Vinod D.Rangari, Pharmacognosy And Phytochemistry-I, Vol-I,II Career Publications, 2008.
4. Dhanashri Sanjay Koli, Abhyangshree Nandkumar Mane, Vinayak Balu Kumbhar, Kalyani Sanjay Shaha, formulation & evaluation of herbal anti-acne face wash, world journal of pharmacy and pharmaceutical sciences, 5(6): 2001-2007.
5. Singh H.P., Samnhotra N., Gullaiya S., Kaur I., "nti-acne synergistic Herbal face wash gel Formulation, Evaluation, & Stability study", World Journal of Pharmaceutical Research, 2015; 4(9): 1261-1273.
6. Kubo I, Muroi H, Kubo, "Naturally occurring anti-

- acne agents", J Nat Prod, 1994; 57(1): 9-17.
7. A.Vijayalakshmi, A. Tripura and V. Ravichandiran; Development and Evaluation of Anti- Acne Products from Terminaliaarjuna Bark; IJCRGG, 3(1): 320-327.
 8. Panigrahi L, Ghosal SK, Pattnaik S, Maharana L, Barik BB; Effect of permeation enhancers on the Release and permeation kinetics of Lincomycin Hydrochloride gel formulations through Mouse skin. Indian J Pharm Sci., 2006; 205-211. VJSM's Vishal Institute of Pharmaceutical Education And Research, Ale, Pune for providing all the facilities to conduct this work.
 9. Tropical journal of pharmaceutical research, December 2013; 12(6): 877-884.
 10. Harsharan Pal Singh, Neeraj Samnhotra, Sumeet Gullaiya, Ishpreet Kaur, anti-acne synergistic herbal face wash gel: formulation, evaluation and stability studies, World Journal of Pharmaceutical Research, 4(9): 1261-1273.
 11. www.sciencedirect.com
 12. www.ijddr.in drug development.
 13. www.gattefosse.com Excipients for pharmaceutical gel formulation.
 14. www.ncbi.nlm.nih.gov. combined antioxidant effects.
 15. Lacmann evaluation parameters and stability studies.