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Formulation And Evaluation of Anti-Acne Gel Containing Rubia Cordifolia Extract

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Abstract: *Herbal materials are very popular in the treatment of skin disorders like acne, aging and inflammation as they are effective and have negligible side effects. Rubia cordifolia also has bioactive compounds including anthraquinones and naphthoquinones that have antimicrobial and anti-inflammatory effects. The current research paper is based on the development and testing of an anti-acne gel with the help of Rubia cordifolia extract. Various formulations (F1, F2, F3) were made and tested on various physicochemical properties such as pH, viscosity, spread ability, and antimicrobial activity. Findings revealed that antimicrobial activity was found to be more effective with increasing extract concentration where formulation F3 was the most active. The research paper concludes that Rubia cordifolia can potentially be used as the natural ingredient in the anti-acne product.*

Keywords: *Anti-acne gel, Rubia cordifolia, Herbal cosmetics, Antimicrobial activity, Acne vulgaris*

I. INTRODUCTION

The role of herbal medicine in healthcare is important because it is readily available, safe, and compatible with the human body. Herbal cosmetics use plant extracts in order to improve the skin health and appearance.

Skin, the largest body organ, serves as a protective layer, and it also has the following functions temperature regulation, sensation, immunity, and excretion.

Acne is a typical condition of the skin that is a result of inflammation of sebaceous glands, overproduction of sebum, bacteria (Propionibacterium acnes), and hormonal disequilibrium. It afflicts the face, chest, and back and greatly influences the quality of life.

1.1. Aim And Objectives

Aim

To develop and test an anti-acne gel with a Rubia cordifolia extract.

Objectives

Selection of ingredients
Preparation of gel formulation.
Incorporation of plant extract.
Evaluation of formulation

2. Pathophysiology Of Acne

The formation of acne is associated with many factors:

Excess sebum production
Bacterial growth (P. acnes)
Abnormalities in keratinization.
Inflammation

Sebum formation forms an anaerobic environment which supports bacterial thriving resulting in inflammation and the formation of lesions.

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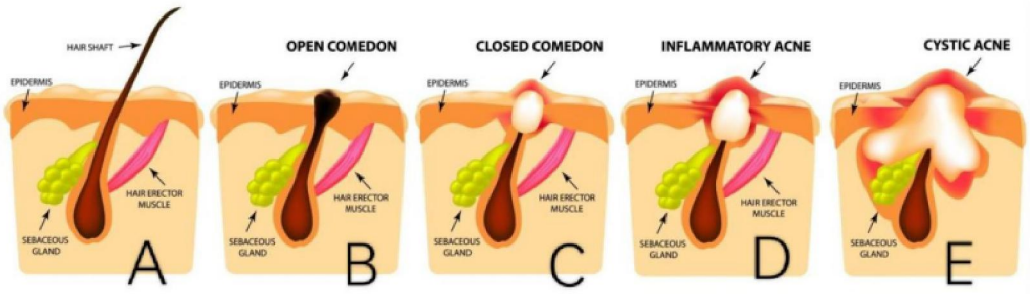

Figure 1: Stages of Acne

- Normal follicle
- Blackhead
- Whitehead
- Papule
- Pustule

The diagram illustrates the stages of the development of acne beginning with a normal follicle to severe inflammatory phases. First, the blockage of the pores causes whiteheads and blackheads. The subsequent growth and inflammation of bacteria lead to the appearance of pustules and papules. This development underscores the need of early intervention to stop severe acne and scarring. It also demonstrates that the microbial activity and accumulation of sebum contribute to the severity of acne.

3. Role Of Rubia Cordifolia

Manjistha is a very common medicinal plant in Ayurveda which is known as Rubia cordifolia. It does have bioactive compounds like:

Anthraquinones
Flavonoids
Tannins

Key properties:

Antimicrobial
Anti-inflammatory
Antioxidant

The properties assist in preventing bacterial proliferation, inflammation and oxidative stress related to acne or it is an acne-causing process.

4. Literature Review

Swati S. Patil. This paper compares the antioxidant and antiacne effects of Rubia cordifolia. The researchers determined the antioxidant effect of the Rubia cordifolia extract through its capacity to scavenge the free radicals as well as reduce oxidative stress, which led them to define the mechanism of action of the Santi acnes effect of the Rubia cordifolia extract. They discovered that the extract suppressed the growth of Propionibacterium acnes, which is a bacteria strongly linked to the occurrence of acne. Moreover, Rubia cordifolia extract decreased sebum production that is another contributing factor to the formation of acne.

Bhavana Pal. The article is a literature review of Manjishtha, phytoconstituents, and its medical applications. The authors write about the classical applications of Manjishtha in Ayurveda and its medicinal value. They point out its several uses in the treatment of diverse health conditions. The review discusses chemical composition of Manjishtha,

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such as glycosides, anthraquinones and other bioactive compounds, which are contributing factors to the pharmacological effects of Manjishtha. The medicinal attributes of Manjishtha used by the authors include the use of this plant as anti-inflammatory, antioxidant, antimicrobial, and hepatoprotective.

Namrata Joshi . The article critically reviews the Ayurvedic Var have herbs and the possibility of their usage as tyrosinase inhibitor. It has addressed the significance of the tyrosinase inhibition in the management of the skin pigmentation disorders and the phytoconstituents of Varnalya herbs which help in this process, including flavonoids, phenolic compounds, and tannins. The article reports on the systems of the tyrosinase inhibition by these herbs and the possibility of their application in cosmetic and pharmaceutical products.

Bafna A. The paper compared the wound healing capacity of Rubia cordifolia L. (Indian madder) crude extract on mice. The experiment must have used the mice where they were induced to have wounds and they were then treated with the extract, to see the effect of healing. It is possible that results would have indicated faster wound healing or better tissue regeneration in contrast to control groups. Such parameters as the decrease in the wound size, histological examination, and the degree of inflammation were probably measured.

5. Materials And Methods

5.1 Ingredients Used

Table 1: Composition of Gel

Sr. No	Ingredient	Function
1	Carboxymethylcellulose	Gelling agent
2	Propylene Glycol	Solvent
3	Glycerin	Humectant
4	Methyl Paraben	Preservative
5	Water	Solvent
6	Rubia cordifolia extract	Active ingredient

5.2 Instruments Used

Table 2: Instruments

Sr. No	Instrument	Model
1	Digital Balance	Anamed
2	pH Meter	Equip Tonic
3	Heating Mantle	Smita
4	Magnetic Stirrer	Smita
5	Viscometer	ViscoQC 100

5.3 Method of Preparation

Authenticated and collected plant material.
Hydroalcoholic method of extraction.
Gel base prepared using CMC
Base incorporated into extract.
Formulations F1, F2, F3 prepared

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Figure 2: Methodology Flowchart

The flow chart methodology is a process of the development of the formulation. The process begins with plant collection and authentication and is used to guarantee reliability of raw material. Active constituents are isolated by extraction, and then gel formulation and extract incorporation are done. Assessment guarantees efficiency and quality. This systematic approach enhances scientific validity and reproducibility of the formulation process.

Figure 3: Soxhlet Extraction of Rubia cordifolia

The Soxhlet extraction method was used to obtain bioactive constituents from Rubia cordifolia stem. Continuous hot extraction ensures efficient separation of phytochemicals such as anthraquinones and flavonoids. The controlled heating and solvent recycling improve extraction yield and purity. This method enhances the therapeutic effectiveness of the extract used in gel formulation.

Table: 3 Formulation of Anti-Acne Gel Containing R.C Extract

Sr. No.	Ingredients	F1 (40 gm)	F2 (40 gm)	F3 (40 gm)
1	Carboxymethylcellulose	0.8 gm	0.8 gm	0.8 gm
2	Propylene Glycol	4 gm	4 gm	4 gm
3	Glycerin	2 ml	2 ml	2 ml
4	Methyl Paraben	0.08 gm	0.08 gm	0.08 gm
5	Water	32.7 ml	32.7 ml	32.7 ml
6	Rubia cordifolia Extract	0.4 gm	0.8 gm	1.6 gm

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The formulation of anti-acne gel was prepared using different concentrations of *Rubia cordifolia* extract (F1, F2, F3). All other ingredients were kept constant to evaluate the effect of extract concentration on antimicrobial activity. The increase in extract concentration from F1 to F3 helps in assessing the enhanced therapeutic effectiveness of the formulation.

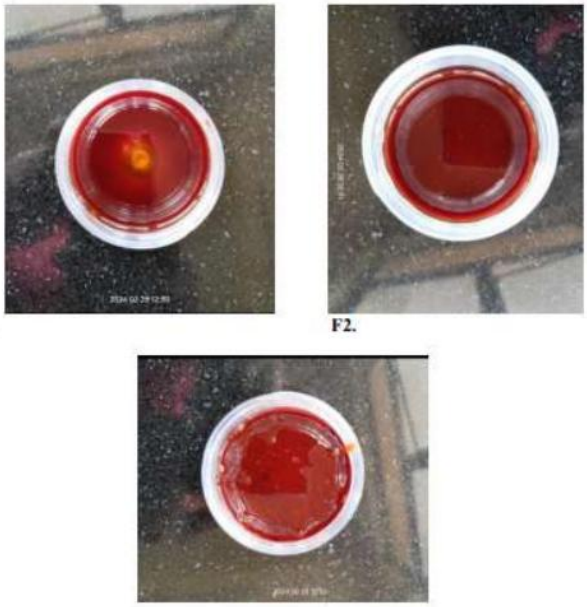

Figure 4: Evaluation of Formulation

The images show increasing antimicrobial activity from F1 to F3, indicated by clearer zones of inhibition. F3 exhibits maximum bacterial suppression, confirming higher extract concentration enhances effectiveness against acne-causing microorganisms.

6. Evaluation Parameters

The formed gels were tested in terms of:

pH
Viscosity
Spreadability
Antimicrobial activity

7. Results and Discussion

7.1 Antimicrobial Activity

The antimicrobial activity increased with extract concentration.

Table 4: Antimicrobial Activity (Zone of Inhibition)

Formulation	Extract Conc. (gm)	Zone of Inhibition (mm)
F1	0.4	8 mm
F2	0.8	12 mm
F3	1.6	13 mm

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The findings have shown that antimicrobial activity is directly proportional to the concentration of Rubia cordifolia extract. Formulation F1 had low activity whereas F2 had moderate bacterial growth inhibitory activity. F3 showed the best antimicrobial effect indicating optimal extract concentration. This affirms the antibacterial property of Rubia cordifolia against microorganisms that cause acne. The results confirm the assumption that the use of herbal extracts as alternatives to synthetic anti-acne agents is possible.

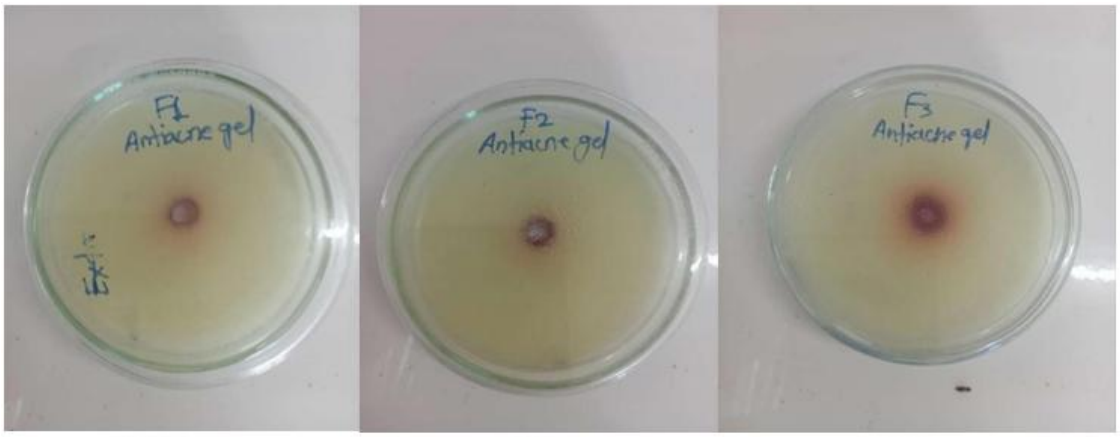

Figure 5: Antimicrobial screening of formulated gel

The antimicrobial activity was evaluated using the agar well diffusion method. The presence of clear zones of inhibition around the wells confirms the antibacterial effectiveness of Rubia cordifolia extract. Formulation F1 exhibited the smallest inhibition zone, while F3 showed the largest zone, indicating superior antimicrobial activity. This demonstrates a concentration-dependent response, where higher extract concentration enhances antibacterial efficacy against acne-causing microorganisms.

7.2 Physicochemical Evaluation

pH: Skin application is acceptable.
Viscosity: Satisfactory consistency.
Spread ability: Good application property

Table 5: Physicochemical Evaluation of Gel Formulations

Parameter	F1	F2	F3
pH	6.2	6.5	6.8
Viscosity (cps)	2100	2500	2900
Spreadability (g·cm/sec)	12	15	18

The physicochemical evaluation indicates that all formulations are suitable for topical application. The pH values are within the acceptable skin range, minimizing irritation. Viscosity increased with extract concentration, improving gel stability and retention time on the skin. Spreadability also improved, ensuring ease of application. Among all formulations, F3 showed optimal characteristics, indicating better formulation stability and user acceptability.

8. Discussion

The paper indicates that Rubia cordifolia is effective in the treatment of acne because it has antimicrobial and anti-inflammatory characteristics. Its therapeutic potential is confirmed by the elevated antimicrobial effect in a greater extract concentration.

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The benefits of herbal preparations include:
Reduced side effects
Better skin compatibility
Natural origin
The results are in agreement with the Ayurvedic use of Manjistha in skin disorders.

9. Mechanism Of Action Of Rubia Cordifolia
Rubia cordifolia has a variety of effects on acne:
Antibacterial Action: Blocks the Propionibacterium acnes growth, which helps in preventing infections.
Anti-inflammatory Effect: Reduces the presence of swelling, redness, and inflammation caused by cytokines.
Sebum Regulation: Helps to check high production of oil so as not to block the pores.
Antioxidant Activity: Inhibits the formation of free radicals that form as a result of UV exposure.

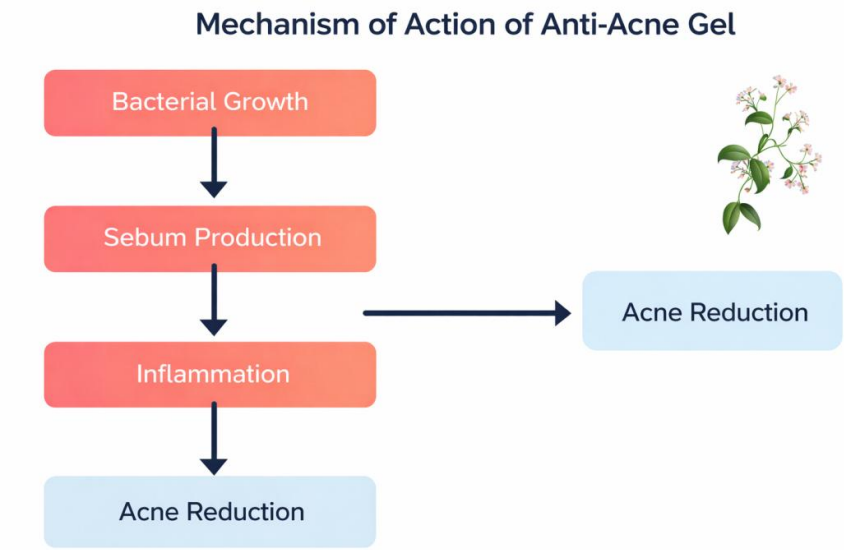

Figure 6: Mechanism of Action of Anti-Acne Gel

This value depicts the poly-targeted action of Rubia cordifolia on acne. The extract works by preventing the growth of bacteria, excessive sebum secretion, and inflammation. A combination of these measures helps to avoid the pores clogging and acne lesions. The antioxidant effect also helps to prevent oxidative stress on skin which makes the skin to heal better and be healthier.

10. Advantages Of Herbal Gel Formulation
Natural and not harmful to the long run.
Side effects are minimal as compared to synthetic drugs.
Better patient compliance
Cost-effective formulation
Green and environmentally friendly.

Table 6: Herbal vs Synthetic Anti-Acne Products

Parameter	Herbal Gel	Synthetic Products
Safety	High	Moderate
Side Effects	Minimal	High

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Cost	Low	High
Compatibility	Good	Moderate

The comparison reveals that herbal formulations have enormous benefits as compared to synthetic products. Herbal gels are less toxic, better tolerated by the skin, and less toxic. Artificial treatments can give quicker outcomes but, in most cases, can be irritating and can be damaging in the long-run. Hence, herbal preparations such as Rubia cordifolia gel provide a sustainable and balanced treatment of acne.

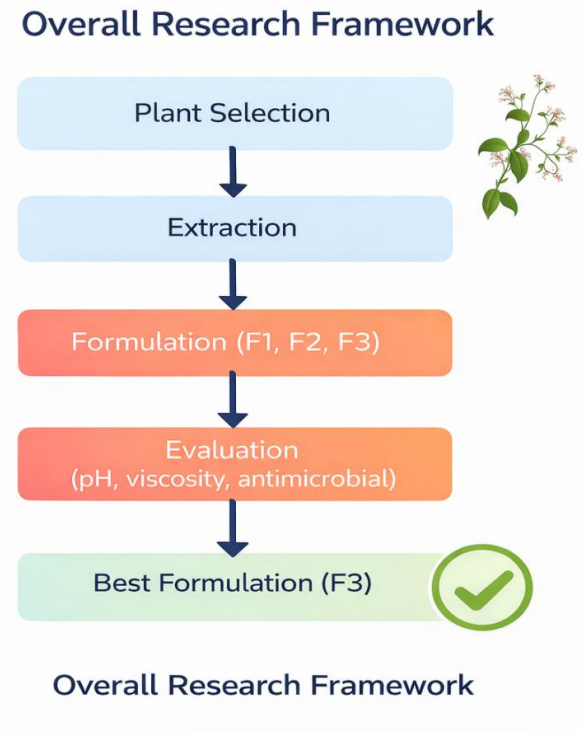

Figure 7: Overall Research Framework

This framework is an overview of the whole study process including the selection of plants and assessment in the end. It points out the systemic development in formulation. The quality and effectiveness of the products is secured by the parameters of evaluation. The formulation (F3) is found to be the best and this shows how optimization is vital in the study of pharmaceutical formulation.

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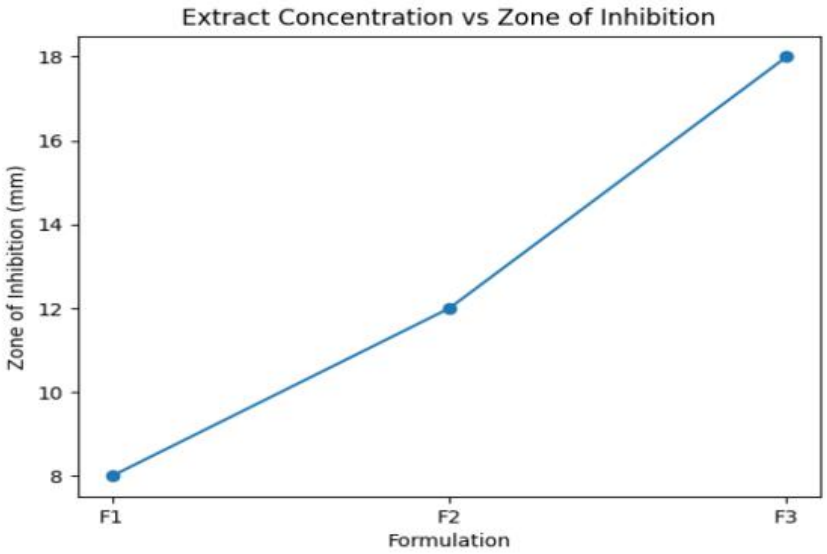

Figure 8: Extract Concentration vs Antimicrobial Activity

The graph clearly illustrates a positive correlation between extract concentration and antimicrobial activity. Formulation F1 exhibited minimal inhibition, while F3 demonstrated the highest inhibition zone. This confirms a strong dose-response relationship, where increasing the concentration of Rubia cordifolia extract enhances its antibacterial effectiveness. The results validate formulation F3 as the optimized formulation for anti-acne activity. The graphical representation strengthens the reliability of experimental findings.

Relationship Between Extract Concentration and Activity

The research study shows clearly that extract concentration is directly correlated with the antimicrobial activity. The antibacterial effect of the F1, F2, and F3 concentrations of Rubia cordifolia is also greater with an increase in the concentration. This indicates a dose- effect relationship, which proves the therapeutic efficacy of the extract in topical treatment of acne.

11. Limitations Of The Study

Analysis confined to laboratory analysis.
Nosocomial trials not done.
Minimal number of formulations tested (F1- F3)
Not long stability period of study.

12. Future Scope

Human subject clinical trials.
Innovation of high-end formulations (cream, serum)
Herbal extracts combination.
Long-term stability studies
Commercial product development.

13. Conclusion

The research was able to develop and test an anti-acne gel which used Rubia cordifolia extract. Formulation demonstrated potential antimicrobial activity and appropriate physicochemical characteristics.

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It was concluded that formulation F3 is the most effective one, so the more the extract concentration, the higher is its efficacy. The findings indicate that Rubia cordifolia is a natural and effective alternative in the treatment of acne.
This paper justifies the increased need of herbal cosmetic preparations with fewer side effects and high therapeutic content.

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