

RESEARCH PAPER

Formulation And Experimental Evaluation of a Polyherbal Topical Lotion For Alopecia In Companion Animals.

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Abstract

Alopecia is a common dermatological disorder in companion animals characterized by partial or complete hair loss caused by factors such as microbial infections, Bacterial infection, fungal infection, fleas allergy dermatitis, Stress and parasitic infestations. Conventional treatments available for alopecia often exhibit limitations, including adverse effects and reduced long-term effectiveness. Consequently, herbal medicines have emerged as promising alternatives due to their therapeutic efficacy, safety, and minimal side effects. The present study aimed to formulate optimize and evaluate a polyherbal topical lotion for the management of alopecia in companion animals. Selected herbal ingredients with established hair growth-promoting, antimicrobial, and anti-inflammatory properties were utilized in the formulation. Herbal extracts were prepared using suitable extraction methods and subjected to preliminary phytochemical screening for the identification of major phytoconstituents. The polyherbal topical lotion was formulated using hydroalcoholic extracts of Bhringraj, Aloe vera, and Neem along with appropriate excipients. The developed formulations were evaluated for physicochemical parameters. The results demonstrated satisfactory physicochemical characteristics, good stability, indicating that the formulated lotion may serve as a safe and effective therapeutic option for alopecia in companion animals. Optimized formulation (F3) exhibits satisfactory physicochemical characteristic and showed antimicrobial activity against E.coli .DPPH activity also demonstrate antioxidant activity. These findings indicate that the optimized polyherbal lotion possesses acceptable physicochemical characteristics ,reproducible distribution of herbal constituents ,sustained in -vitro release and relevant antioxidant and antimicrobial properties The formulation therefore represents a promising topical platform for further investigation in alopecia associated conditions in companion animals.

Keywords: Alopecia, Polyherbal Topical Lotion, Companion Animals, Herbal Extracts, DPPH ,Antimicrobial activity.

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1. INTRODUCTION

Many companion animals, especially cats and dogs, suffer from alopecia, a skin disorder that causes thinning or full hair loss in typically hair-bearing regions.^[1] There is a wide variety of potential causes of hair loss in animals. These include things like hormonal imbalances, poor nutrition, allergies, parasite infestations, microbial infections, immune-mediated illnesses, stress in the environment, improper grooming, and genetic predisposition. Persistent alopecia has an impact on the animal's look, but it can also cause dryness, redness, itching, inflammation, and secondary infections of the skin, which can harm the animal's health in general. In order to treat alopecia effectively, one must first determine what's causing it. Then, one must take the necessary steps to support healthy hair growth and keep the skin in good condition.^[1,2,3]

The traditional treatment of alopecia can be topical or systemic pharmacological according to its etiology. Nevertheless, long-term or incorrect use of some therapeutic agents may be linked with such negative effects as adverse effects, irritation, unstable therapeutic responses and long-term issues.

acceptability. As a result, there is growing interest in plant-derived ingredients, herbal topical preparations as complementary tools to skin and hair health maintenance^[3]. Medicinal plants possess a range of biologically active compounds, such as flavonoid, phenolic, terpenoid, alkaloid,

tannin, saponin and other phytochemical compounds that could have antioxidant, antimicrobial, anti-inflammatory and skinprotective properties. These properties give the scientific basis to explore properly chosen herbs constituents in topical preparation that would be used in alopecia related skin conditions.^[4,5]

In a polyherbal approach, multiple medicinal plant constituents are combined in one formulation to achieve biological effects that are either complementary to each other or may even be synergistic. Several potential functional activities pertinent to alopecia may be provided by a combination of carefully chosen herbal compounds. These include reducing local inflammatory responses, protecting the scalp or skin microenvironment, and supporting the activity of hair follicles.^[6] The medicinal properties of herbs do not, however, guarantee a successful topical formulation. In order to obtain a good dispersion of active ingredients, physical stability, skin compatibility, and easy application, it is crucial to develop the formulation correctly.^[7]

Due to their low viscosity, ease of spreading, quick application, and capacity to cover relatively broad affected surfaces without creating severe greasiness, topical lotions are ideal for use over hair-bearing areas. A polyherbal lotion's efficacy and user-friendliness are affected by its consistency, homogeneity, viscosity, spreadability, physicochemical stability, and

compatibility of its ingredients, among other formulation features. Therefore, in order to provide a consistent and repeatable product with properties that are appropriate for topical use in companion animals, rigorous formulation and experimental assessment are required.^[8,9]

A polyherbal topical lotion for alopecia in companion animals was developed and tested in this study because of the increasing interest in plant-based topical therapies and the fact that alopecia affects many different body systems. In addition to the experimental efficacy parameters that were really part of the investigation, the prepared substances were methodically evaluated utilising pertinent physicochemical, formulation-performance, and stability criteria. The objective of this work

Formulation Table:

Table no.01 Formulation table

Sr.No	Drug	Quantity	Role
1	Cetostearyl alcohol	2.5 gm	Thickening agent
2	Liquid paraffin	2.94 ml	Emollient
3	Span 80	1.25 ml	Lipophilic emulsifying agent
4	Tween 80	1.40 ml	Hydrophilic emulsifying agent
5	Propylene glycol	3.62 ml	Humectant ,solvent & penetration enhancer
6	Propyl paraben	0.025 gm	Preservative
7	Bhringraj extract	0.75 gm	Promote hair growth
8	Neem extract	1.25 gm	Antimicrobial ,antibacterial & antiinflammatory
9	Aloe vera extract	0.05 gm	Soothing ,moisturizing & skin conditiong agent
10	Distilled water	13.26 ml	Vehicle

2.2 Methods

Step 1 - Hydroalcoholic Extraction of Herbs :

Using a 250 ml ethanol-water solvent system, about 50 g of each powdered item was hydroalcoholically extracted for six to seven hours. The powders were first macerated for 48 hours at room temperature with occasional stirring, then filtered using Whatman No. 4 filter paper and concentrated. An alternative method called Soxhlet extraction was used. This involved placing the powdered material into a cellulose thimble and then extracting it with around 250 mL of solvent for about 6-7 hours. The resulting extracts were then concentrated and kept in the fridge.^[11]

Step 2 -Preparation of Topical Lotion :

Separately, the oil and water phases were heated to 70-75°C. The oil phase contained cetostearyl alcohol, liquid paraffin, and Span 80, while the water phase contained distilled water, propylene glycol, Tween 80, and propyl paraben. After the oil and water phases were combined slowly while stirring constantly, the mixture was cooled to 40-45°C. Then, extracts of Bhringraj, Neem, and Aloe vera were added while stirring continuously until a uniform lotion was achieved.^[12]

2.3 Evaluation Tests of Polyherbal Topical Lotion

A. Appearance: The formulation was visually examined for its overall physical appearance and acceptability.^[13]

B. Colour: The lotion was observed visually for uniform and characteristic colour.^[13]

was to find a better formulation with good topical properties and to show that the polyherbal lotion could be useful for managing alopecia in companion animals through experimentation. [10]

2. MATERIALS AND METHODS

2.1 Materials

The herbal and pharmaceutical materials used for the formulation and experimental evaluation of the polyherbal topical lotion included Bhringraj, Neem, Aloe vera, cetostearyl alcohol, liquid paraffin, Span 80, Tween 80, propylene glycol, propyl paraben, and distilled water.

C. Odour: The formulation was evaluated for characteristic and acceptable odour.^[13]

D. Homogeneity: The lotion was checked visually for uniformity and absence of lumps or phase separation.^[13]

E. pH: The pH of the formulation was measured using a calibrated digital pH meter.^[14]

F. Viscosity: The viscosity of the lotion was determined using a Brookfield viscometer.^[13]

G. Spreadability: Spreadability was determined by the glass-slide method to assess ease of application on the skin.^[13]

H. Moisture Content: Moisture content was determined by the loss-on-drying method at approximately 105°C.^[13]

I. Drug Content Uniformity: UV-Visible spectrophotometric analysis was performed using characteristic analytical wavelengths of 351 nm for Bhringraj, 275 nm for Neem and 280 nm for Aloe vera.^[15]

J. In-vitro Diffusion Study: Over the course of the trial, the cumulative release of Bhringraj, Neem, and Aloe vera increased gradually according to their in-vitro diffusion profiles. The release values that are comparable are displayed.^[16]

K. Antimicrobial Activity: The agar-well diffusion method was used to assess the antimicrobial efficacy of

the optimised polyherbal lotion against *Escherichia coli* ATCC 8739. [17,18,19]

L. Antioxidant Activity: In order to determine the polyherbal lotion's antioxidant capability, we compared

it to ascorbic acid and used the DPPH radical scavenging assay. Antioxidant activity was shown to be concentration dependent in both samples.^[20]

Table no.02 Batch Formulation

Ingredients	F1	F2	F3	F4	F5
Cetostearyl alcohol(gm)	0.5	2.5	2.5	2.5	1.5
Liquid paraffin(ml)	7.5	2.5	2.94	7.5	5.8
Span 80 (ml)	1.26	0.13	1.25	1.25	0.69
Tween 80(ml)	1.42	0.71	1.4	1.4	1.06
Propylene glycol(ml)	3.6	3.6	3.6	3.6	3.6
Bhringraj (gm)	0.75	0.75	0.75	0.75	0.75
Neem (gm)	1.25	1.25	1.25	1.25	1.25
Aloe vera(gm)	0.05	0.05	0.05	0.05	0.05

3.RESULTS AND DISCUSSION

3.1 Preformulation Characterization

It was necessary to assess the preformulation properties of Bhringraj, Neem, and Aloe vera before adding them to the polyherbal topical lotion. While neem was a dark brown with a strong scent and harsh taste, bhringraj was a dark greenish-brown with a distinctive herbal aroma. There was a small bitterness to the taste, a minor odour, and a brownish-black look to the aloe vera powder. Initial confirmation of the herbal ingredients identification and overall quality was supplied by these distinctive organoleptic characteristics.

There were noticeable variations in the solubility characteristics of the various herbal components. Although Bhringraj was soluble in water and ethanol, Neem was more soluble in isopropyl alcohol and ethanol but had poor solubility in water. Aloe vera was soluble in both water and ethanol, and

it had a relatively high aqueous solubility. The solubility of all three substances in acetonitrile was found to be rather low. The overall solubility behaviour allowed for the recovery of components with varied polarity using a combination aqueous-organic solvent environment, which facilitated the usage of a hydroalcoholic system during extraction.

3.2 Preliminary Phytochemical Screening

Table 1 shows that all three of the herbal materials that were chosen for qualitative phytochemical screening contained alkaloids, glycosides, flavonoids, proteins, and carbohydrates. Further evaluation of the polyherbal system's antioxidant, antibacterial, and topical formulation performance is warranted due to the concurrent presence of many classes of phytoconstituents, which exhibit the phytochemical complexity of the system.

Table no.03 Preliminary phytochemical profile of the selected herbal materials

Phytoconstituent	Bhringraj	Neem	Aloe vera
Alkaloids	+	+	+
Glycosides	+	+	+
Flavonoids	+	+	+
Proteins	+	+	+
Carbohydrates	+	+	+

“+” indicates presence of the respective phytoconstituent.

3.3 Total Phenolic Content of Bhringraj Extract:

The Bhringraj extract also exhibited a progressive increase in total phenolic content with increasing concentration. The phenolic content increased from **3.50 mg GAE/g extract at 10 µg/mL to 65.91 mg GAE/g extract at 100 µg/mL**. With a R^2 value of 0.9905, the Bhringraj extract's calibration relationship demonstrated excellent linearity. It was confirmed that the Bhringraj extract contained quantifiable amounts of phenolic compounds by the concentration-dependent rise and good

linear relationship. While phenolic chemicals are known to have redox-modulating effects, it is important to note that this assay should be seen more as phytochemical characterisation than proof of antialopecia activity, even if they are highly relevant in herbal topical systems.

3.4 Statistical Analysis:

Tween 80 and Span 80 were examined for their potential effects on formulation reactions using response-surface analysis. In the optimised region, the total desirability hit 1.000. The anticipated viscosity was close to 20 cP, while the moisture

response was at 14%. These responses showed only minor fluctuations across the surfactant ranges that were evaluated, suggesting that the formulation was relatively robust within the experimental domain that was examined.

There was relatively little interaction between the surfactants and the three-dimensional moisture-content response surface, since there was only a little inclination throughout the tested concentrations of Tween 80 and Span 80.

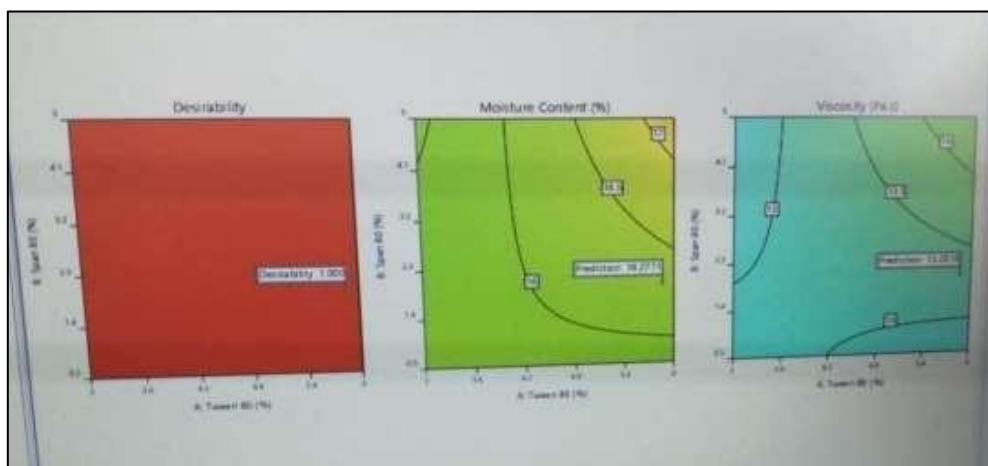


Figure no 3. Two-dimensional response-surface contour plots illustrating the effects of Tween 80 and Span 80 on desirability, moisture content and viscosity of the polyherbal lotion.

The 3D response surface plot shows that the polyherbal topical lotion's moisture content is quite consistent across all of the Tween 80 and Span 80 concentrations that were investigated. The low degree of interaction between the two emulsifiers, as shown by the almost flat response surface, is indicative of a strong formulation that can

sustainably keep its moisture content within the specified range.

$$Y_1 (\text{Moisture Content}) = 1.30297 + 0.940116 \times \text{Tween 80} + 0.001642 \times \text{Liquid paraffin} + 0.008654 \times \text{Cetostearyl Alcohol} + 0.002957 \times \text{Liquid paraffin} \times \text{Cetostearyl Alcohol} - 0.102404 \times \text{Tween 80}^2$$

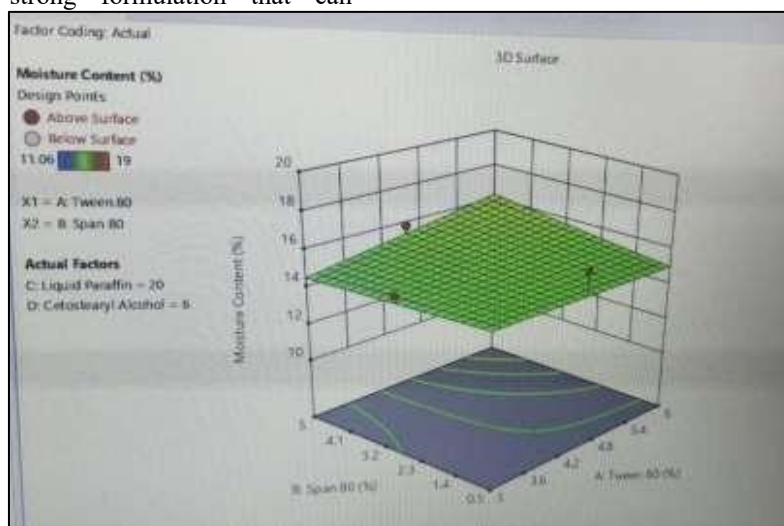


Figure no 4. Three-dimensional response-surface plot showing the combined effects of Tween 80 and Span 80 on predicted moisture content of the polyherbal lotion.

Similarly, viscosity response surface exhibited only minor curvature throughout the investigated formulation region, indicating that viscosity remained comparatively stable within the evaluated surfactant ranges. The 3D graph illustrates the relationship between the viscosity (cP) of the polyherbal topical lotion and two independent variables: Tween 80 (%) and Span 80 (%). The graph

is a response surface plot that graphically represents the effect of these formulation variables on the viscosity of the optimized lotion.

$$Y_2 (\text{Viscosity}) = 1.90527 + 0.573605 \times \text{Tween 80} + 0.077936 \times \text{Cetostearyl Alcohol} - 0.059391 \times \text{Tween 80}^2$$

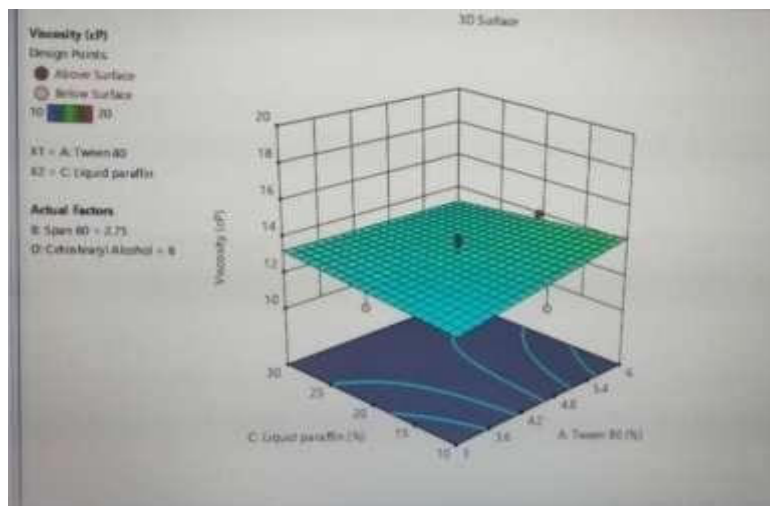


Figure no 5. Three-dimensional response-surface plot showing the combined effects of Tween 80 and Span 80 on predicted viscosity of the polyherbal lotion.

3.5 Physicochemical Evaluation of Formulation :

All prepared formulations exhibited a yellowish-brown appearance, smooth texture, characteristic odour, good

washability and homogeneous consistency without visible phase separation . These observations suggested satisfactory macroscopic compatibility of the lotion components .

Table no.04 Physicochemical evaluation

Parameter	F1	F2	F3	F4	F5
Appearance	Yellowish- brown	Yellowish- brown	Yellowish- brown	Yellowish- brown	Yellowish- brown
Texture	Smooth	Smooth	Smooth	Smooth	Smooth
Phase separation	No	No	No	No	No
Homogeneity	Homogeneous	Homogeneous	Homogeneous	Homogeneous	Homogeneous
Odour	Characteristic	Characteristic	Characteristic	Characteristic	Characteristic
Washability	Good	Good	Good	Good	Good
Solubility	Soluble	Soluble	Soluble	Soluble	Soluble
pH	6.68	7.31	6.31	7.81	7.19
Moisture content (%)	12.05	13.00	14.00	18.65	15.05
Viscosity (cP)	11	15	20	15	14
Spreadability (g.cm/s)	-	-	5.04	-	-
Drug content (%)	-	-	95-97	-	-

3.6 Drug Content Uniformity

With content uniformity values of 96.05%, 97.27%, and 95.55%, respectively, Bhoringraj, Neem, and Aloe vera were tested. With matching %RSD values of 0.76%, 1.23%, and 0.76%, the variability among the repeat measurements was relatively low. The consistent distribution of the detected

marker components across the tested formulation is supported by the low %RSD values.

3.7 In-Vitro Release Study

The in-vitro diffusion profiles of Bhoringraj, Neem and Aloe vera showed gradual increases in cumulative release throughout the experimental period. The comparative release values are presented in

Table no.05 In-vitro drug release

R ² value of extract	Zero order model	First order model	Higuchi model	Korsmeyer - Peppas model	Best Fit Model
Bhringraj	0.9911	0.9869	0.8881	0.9927	Korsmeyer -Peppas model
Neem	0.9871	0.994	0.959	0.992	First order model
Aloe vera	0.9958	0.9945	0.8885	0.9957	Zero order model



Figure no 6. In-Vitro release study

3.7.1 Bhringraj Release Kinetic

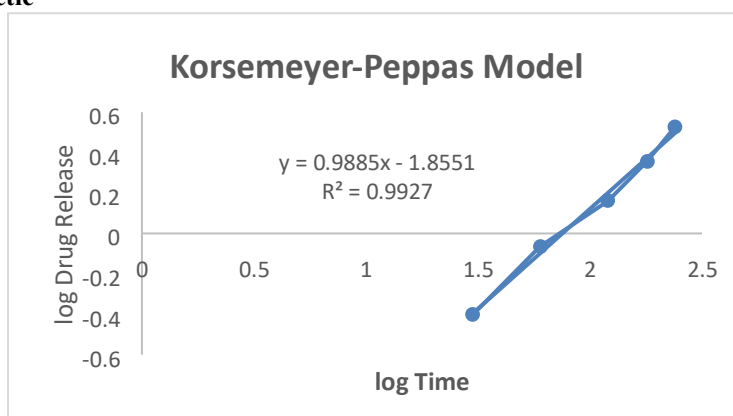


Figure no 7. In-vitro release Kinetic of Bhringraj from the optimized polyherbal lotion fitted to Korsmeyer- Peppas Model

3.7.2 Neem Release Kinetic

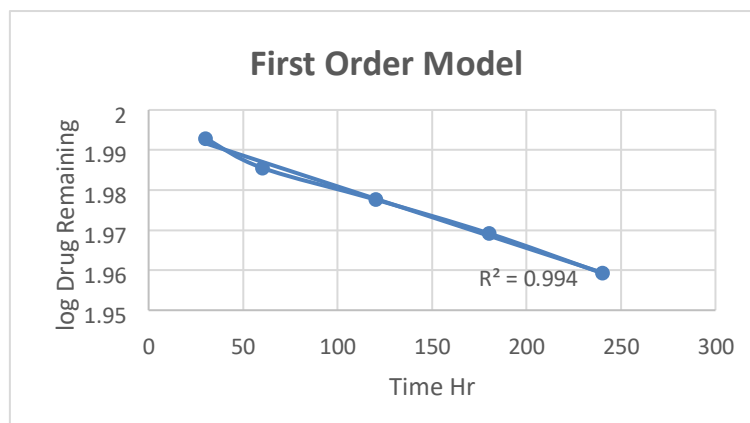


Figure no 8. In-vitro release Kinetic of Neem from the optimized polyherbal lotion fitted to First Order Model

3.7.3 Aloe vera Kinetic

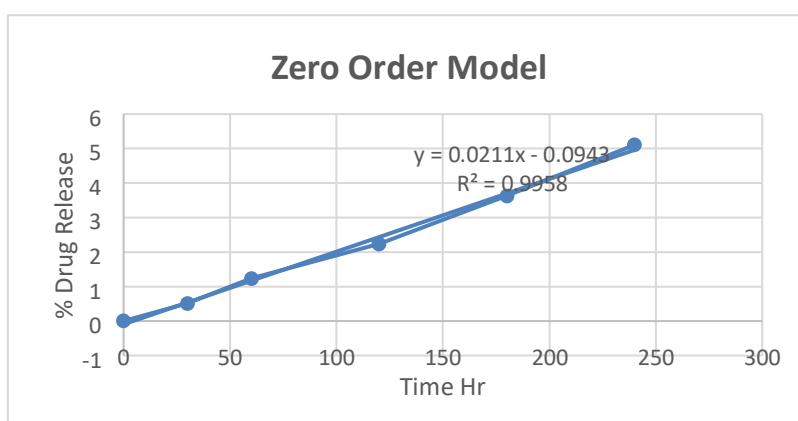


Figure no 9. In-vitro release Kinetic of Aloe vera from the optimized polyherbal lotion fitted to Zero Order Model

Although the amount and kinetic behaviour varied among the different extracts, the diffusion data show that all three of the assessed herbal components were released sustainably.

3.8 Antimicrobial Activity

Streptomycin at 1 mg/mL produced a 32 mm inhibition zone. The polyherbal lotion produced inhibition zones of 17 mm at 5 mg/mL and 22 mm at 10 mg/mL (Table 6).



Figure no 10. Representative agar-well diffusion plate showing antimicrobial activity of the optimized polyherbal lotion against *Escherichia coli* ATCC 8739.

Table no.06 Antimicrobial activity of the optimized polyherbal lotion

Sample	Concentration	Zone of inhibition (mm)
Negative control	—	—
Streptomycin	1 mg/mL	32
Polyherbal lotion	5 mg/mL	17
Polyherbal lotion	10 mg/mL	22

An indication of concentration-dependent antibacterial activity is the fact that the inhibition-zone diameter increases from 17 to 22 mm as the lotion concentration increases. Because the standard and formulation were tested at various concentrations and represent chemically different test systems, it is important to read directly potency comparisons with streptomycin with caution.

3.9 DPPH Free-Radical Scavenging Activity

Ascorbic acid showed 27.81% scavenging at 10 $\mu\text{g/mL}$ and 96.81% at 100 $\mu\text{g/mL}$, whereas the polyherbal lotion increased from 9.29% to 97.33% over the same concentration range.

Table no.07 DPPH radical-scavenging activity of ascorbic acid and polyherbal lotion

Concentration ($\mu\text{g/mL}$)	Ascorbic acid scavenging (%)	Polyherbal lotion scavenging (%)
10	27.81	9.29
20	49.96	30.60
40	95.84	69.26
60	96.10	95.71
80	96.29	96.88
100	96.81	97.33

Ascorbic acid showed a reported IC_{50} of approximately **6.645 $\mu\text{g/mL}$** , while the polyherbal lotion showed an IC_{50} of approximately **23.50 $\mu\text{g/mL}$** , indicating that the standard possessed greater antioxidant potency at lower concentrations.

At 60–100 $\mu\text{g/mL}$, however, the polyherbal formulation exhibited high radical scavenging activity approaching that of the reference antioxidant.

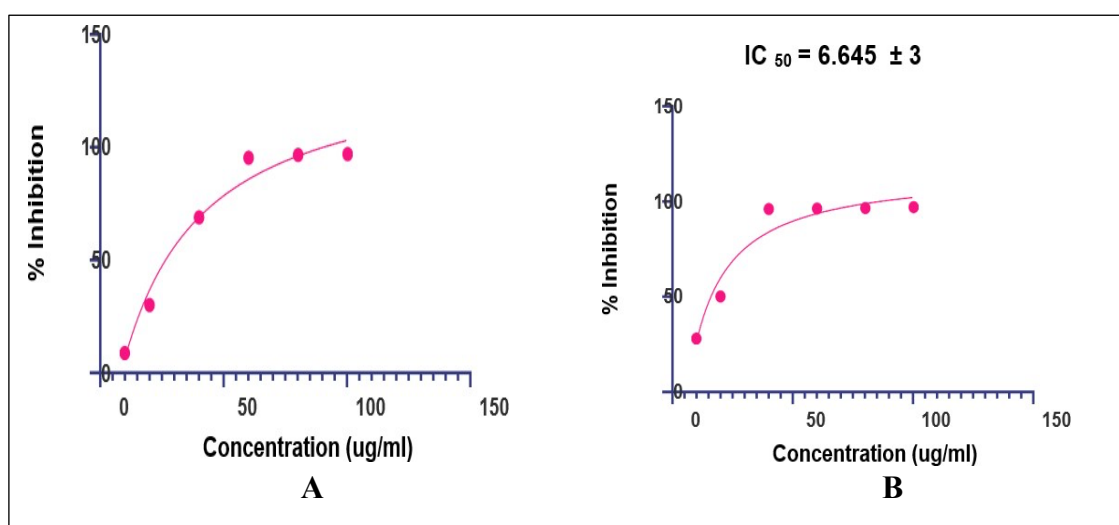


Figure no 11 A: Concentration-response curve of DPPH radical-scavenging activity of the optimized polyherbal lotion .11 B:Concentration-response curve of DPPH radical-scavenging activity of ascorbic acid.

3.10 Stability Data

During the duration of the study, the optimised Lotion did not alter. Colour, look, texture, and other characteristics have not changed noticeably.

Table no.08 Stability data of 3 months

Parameter	Initial	1 month	2 month	3 month
Appearance	Yellowish- brown	Yellowish- brown	Yellowish- brown	Yellowish- brown
Texture	Smooth	Smooth	Smooth	Smooth
Phase separation	No	No	No	No
pH	6.31	6.33	6.94	6.97
Moisture content (%)	14.00	14.70	14.73	14.78

Overall Discussion

The current study was a success in developing a polyherbal topical lotion with Bhringraj, Neem, and Aloe vera as its ingredients. A number of plant components were identified through phytochemical screening and preliminary characterisation, and antioxidant capability was shown by phenolic content and DPPH analysis. Based on the results of the DoE optimisation, the optimal formulation was determined to be F3. This formulation exhibited the following properties: pH 6.31, moisture content 14%, viscosity 20 cP, spreadability 5.04 g.cm/s, and marker-content uniformity of 96.05% for Bhringraj, 97.27% for Neem, and 95.55% for Aloe vera. The in-vitro diffusion method revealed that the three herbal components were released gradually over a period of 240 minutes, with varying rates of release. The lotion's antimicrobial efficacy against *E. coli* was also concentration dependent; at 5 mg/mL, the inhibition zone was 17 mm, and at 10 mg/mL, it was 22 mm. A radical scavenging activity of 97.33% was achieved at 100 µg/mL by the DPPH. Additional research into the use of the optimised formulation for alopecia in companion animals is warranted due to its good physicochemical, content-uniformity, diffusion, antibacterial, and antioxidant characteristics. The only way to determine a treatment's effectiveness against alopecia is to conduct controlled in-vivo hair-regrowth trials.

CONCLUSION

This research optimised and created a polyherbal topical lotion including Bhringraj, Neem, and Aloe vera as its active ingredients. A number of bioactive components were validated in phytochemical and preformulation investigations, and the Bhringraj extract showed a respectable amount of phenolic content in the total phenolic analysis. F3, a formulation with the following desirable properties: pH 6.31, moisture content 14%, viscosity 20 cP, spreadability 5.04 g.cm/s, and good marker-content uniformity, was identified through optimisation based on the Design of Experiments. The in-vitro diffusion method showed that the herbal components were released gradually over a period of 240 minutes. At 100 µg/mL, the optimised lotion inhibited 97.33% of *Escherichia coli* ATCC 8739 and exhibited an antibacterial activity that was concentration dependant. It also exhibited strong DPPH

antioxidant activity. The formulation showed potential antioxidant and antibacterial activity, sustained in-vitro release, and excellent physicochemical qualities overall. Although it shows promise as a topical platform for alopecia-related disorders in pets, more research into its stability, in-vivo hair-regrowth effects, and veterinary clinical trials are needed to determine its therapeutic effectiveness.

REFERENCES

1. Roy RK, Thakur M, Dixit VK. Hair growth promoting activity of *Eclipta alba* in male albino rats. Arch Dermatol Res. 2008;300(7):357–364. <https://doi.org/10.1007/s00403-008-0860-3>
2. Datta K, Singh AT, Mukherjee A, Bhat B, Ramesh B, Burman AC. *Eclipta alba* extract with potential for hair growth promoting activity. J Ethnopharmacol. 2009;124(3):450–456. <https://doi.org/10.1016/j.jep.2009.05.023>
3. Lee KH, Choi D, Jeon SI, Kim SJ, Lee CH, Seo HS, et al. *Eclipta prostrata* promotes the induction of anagen, sustains the anagen phase through regulation of FGF-7 and FGF-5. Pharm Biol. 2019;57(1):105–111. <https://doi.org/10.1080/13880209.2018.1561729>
4. Begum S, Lee MR, Gu LJ, Hossain J, Kim HK, Sung CK. Comparative hair restorer efficacy of medicinal herb on nude (Foxn1nu) mice. Biomed Res Int. 2014;2014:319795. <https://doi.org/10.1155/2014/319795>
5. Begum S, Lee MR, Gu LJ, Hossain J, Sung CK. Exogenous stimulation with *Eclipta alba* promotes hair matrix keratinocyte proliferation and downregulates TGF-β1 expression in nude mice. Int J Mol Med. 2015;35(2):496–502. <https://doi.org/10.3892/ijmm.2014.2022>
6. Jahan R, Al-Nahain A, Majumder S, Rahmatullah M. Ethnopharmacological significance of *Eclipta alba* (L.) Hassk. (Asteraceae). Int Sch Res Notices. 2014;2014:385969. <https://doi.org/10.1155/2014/385969>

7. Yadav NK, Arya RK, Dev K, Sharma C, Hossain Z, Meena S, et al. Alcoholic extract of *Eclipta alba* shows in vitro antioxidant and anticancer activity without exhibiting toxicological effects. *Oxid Med Cell Longev*. 2017;2017:9094641. <https://doi.org/10.1155/2017/9094641>
8. Kesika P, Sivamaruthi BS, Thangaleela S, Bharathi M, Chaiyasut C. Role and mechanisms of phytochemicals in hair growth and health. *Pharmaceuticals* (Basel). 2023;16(2):206. <https://doi.org/10.3390/ph16020206>
9. Choi JY, Boo MY, Boo YC. Can plant extracts help prevent hair loss or promote hair growth? A review comparing their therapeutic efficacies, phytochemical components, and modulatory targets. *Molecules*. 2024;29(10):2288. <https://doi.org/10.3390/molecules29102288>
10. Brunner MAT, Jagannathan V, Waluk DP, Roosje P, Linek M, Panakova L, et al. Novel insights into the pathways regulating the canine hair cycle and their deregulation in alopecia X. *PLoS One*. 2017;12(10):e0186469. <https://doi.org/10.1371/journal.pone.0186469>
11. Rathour M, Malav OP, Kumar P, Chatli MK, Mehta N. Standardization of protocols for extraction of aloe vera and cinnamon bark extracts. *Journal of Animal Research*. 2017;7(1):175-82. DOI: <http://dx.doi.org/10.5958/2277-940X.2017.00024.9>
12. Kusuma S, Mita S, Mutiara A. Antimicrobial lotion containing red Piper betle leaf (*Piper crocatum* Ruiz and Pav) ethanolic extract for topical application. *National Journal of Physiology, Pharmacy and Pharmacology*. 2017;8(1):1.
13. Saptarini NM, Hadisoebroto G. Formulation and evaluation of lotion and cream of nanosized chitosan-mangosteen (*Garcinia mangostana* L.) pericarp extract. *Rasayan Journal of Chemistry*. 2020 Apr 1;13(2):789-95.
14. Fransiska D, Darmawan M, Sinurat E, Sedayu BB, Wardhana YW, Herdiana Y, Setiana GP. Characteristics of oil in water (o/w) type lotions incorporated with kappa/iota carrageenan. In *IOP Conference Series: Earth and Environmental Science* 2021 Mar 1 (Vol. 715, No. 1, p. 012050). IOP Publishing.
15. Ueda CT, Shah VP, Derdzinski K, Ewing G, Flynn G, Maibach H, Marques M, Rytting H, Shaw S, Thakker K, Yacobi A. Topical and transdermal drug products. In *Pharmaceutical forum* 2009 May (Vol. 35, No. 3, pp. 750-764).
16. Maru AD, Lahoti SR. Formulation and evaluation of ointment containing sunflower wax. *Asian J Pharm Clin Res*. 2019 Aug 7;12(8):115-20.
17. Gaikwad, A., Harshad, R., & Patil, S. B. (2024). Formulation, Evaluation, and Antioxidant Properties of Herbal Soap for Anti-Acne Treatment. *International Journal of Novel Research and Development*, 9(8), August 2024. ISSN: 2456-4184. Retrieved from www.ijnrd.org.
18. Hufford CD, Funderburk JM, Morgan JM, Robertson LW (1975). Two antimicrobial alkaloids from heartwood of *Liriodendron tulipifera*. *J. J. pharm. Sci.*, 64:789-792.
19. Umadevi S, Mohanta GP, Chelladurai V, Manna PK, Manavalan R (2003). Antibacterial and antifungal activity of *Andrographis echinodes*. *J. Nat. Remedies.*, 3:185-188.
20. Heř M, Dziedzic K, Górecka D, Jędrusek-Golińska A, Gujska E. *Aloe vera* (L.) Webb.: natural sources of antioxidants—a review. *Plant Foods Hum Nutr*. 2019;74(3):255–265. <https://doi.org/10.1007/s11130-019-00747-5>
21. Wylie MR, Merrell DS. The antimicrobial potential of the Neem tree *Azadirachta indica*. *Front Pharmacol*. 2022;13:891535. <https://doi.org/10.3389/fphar.2022.891535>
22. Islas JF, Acosta E, G-Buentello Z, Delgado-Gallegos JL, Moreno-Treviño MG, Escalante B, et al. An overview of Neem (*Azadirachta indica*) and its potential impact on health. *J Funct Foods*. 2020;74:104171. <https://doi.org/10.1016/j.jff.2020.104171>
23. Sarkar S, Singh RP, Bhattacharya G. Exploring the role of *Azadirachta indica* (Neem) and its active compounds in the regulation of biological pathways: an update on molecular approach. *3 Biotech*. 2021;11(4):178. <https://doi.org/10.1007/s13205-021-02745-4>
24. Sánchez M, González-Burgos E, Iglesias I, Gómez-Serranillos MP. Pharmacological update properties of *Aloe vera* and its major active constituents. *Molecules*. 2020;25(6):1324. <https://doi.org/10.3390/molecules25061324>
25. Hamman JH. Composition and applications of *Aloe vera* leaf gel. *Molecules*. 2008;13(8):1599–1616. <https://doi.org/10.3390/molecules13081599>
26. Surjushe A, Vasani R, Saple DG. *Aloe vera*: a short review. *Indian J Dermatol*. 2008;53(4):163–166. <https://doi.org/10.4103/0019-5154.44785>
27. Hashemi SA, Madani SA, Abediankenari S. The review on properties of *Aloe vera* in healing of cutaneous wounds. *Biomed Res Int*. 2015;2015:714216. <https://doi.org/10.1155/2015/714216>
28. Chelu M, Musuc AM, Popa M, Calderon Moreno J. *Aloe vera*-based hydrogels for wound healing: properties and therapeutic effects. *Gels*. 2023;9(7):539. <https://doi.org/10.3390/gels9070539>