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Formulation Development And Pharmacological Evaluation Of Polyherbal Gel Containing Extract Of Sesbania Grandiflora Flower, *Eclipta Alba L. Leaf, And Allium Cepa L. Bulb*

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Abstract

Even in places where access to modern medicine is available, interest in using herbal therapies has grown dramatically in recent years. Since medicinal plants are the main source of the bioactive molecules used in both conventional and modern medicine, phytochemicals and herbal medicines have recently attracted a lot of attention. In this study, polyherbal gel, including extracts of Sesbania grandiflora flower, Eclipta alba leaf, and Allium cepa bulb, will be made and tested. The ethanolic extracts were made using the maceration method. The following step included continuously swirling as each ingredient was properly mixed and the Carbopol 934 gel was made. The formulation's physical and chemical characteristics, including colour, aroma, pH, spreadability, extrudability, consistency, solubility, and washability, were assessed once it had been completed. The formulation was tested for physicochemical properties when it was finished,

including colour, odour, pH, spreadability, extrudability, consistency, solubility, and washability. The formulation's further stability testing at various temperatures revealed no changes in irritancy, spreadability, or diffusion. It might therefore develop into a vehicle for effectively and conveniently using the medicinal benefits of polyherbal gel that contains extracts from the sesbania grandiflora flower, eclipta alba leaf, and allium cepa bulb.

Keywords: *Physiochemical parameters, polyherbal gel, sesbania grandiflora flower, eclipta alba l. Leaf, and allium cepa l. bulb ect.*

1. Introduction

Active components found naturally in medicinal plants have the ability to heal illnesses and reduce pain. Traditional remedies and herbal remedies are widely employed in most poor countries as therapeutic agents for preserving good health [1]. Traditional medicines, most of which are derived from herbal plants, are used by over 80% of the population in underdeveloped nations, as reported by the World Health Organization. The healing qualities of these herbs are attributed to the presence of phytochemicals, which have anti-inflammatory, antibacterial, and antipyretic activities [2, 3]. Phytochemicals are the basis for the therapeutic effects of many traditional plant-based medications. People and/or traditional medical practitioners from all over the world have long relied on herbs as safe, effective treatments for a variety of health issues. In spite of numerous reports of herb-related toxicity in the scientific literature, neither the public nor traditional medicine organizations recognize herb toxicity as a legitimate concern [4]. More and more pharmaceuticals are being produced with medicinal plants as the major raw material, which is likely to increase demand for traditional medical services. This is because, despite irrefutable evidence supporting modern medicine's efficacy, its future growth has been stunted by a number of problems [5, 6]. Because contemporary medicine has its flaws, researchers are looking into other options, including traditional and ancient forms of medicine.

Medicinal plants' importance in drug discovery

India, often known as the World's Botanical Garden, is widely believed to be the largest producer of medicinal plants in the world. Traditional medicinal practices such as Ayurveda, Siddha, and Unani have used herbal medicines for thousands of years. India is home to over 14 percent of the world's estimated 3.6 million medicinal plant species [7]. Traditional medical systems use around 70,000 plants worldwide; our forebears relied heavily on plants for medicinal purposes. As Western medicine advanced, the use of herbal therapies declined worldwide [8, 9] due to the widespread belief that synthetic chemicals were the most effective treatments and cures.

Traditional Medicine

The phrase "traditional medicine" is used to refer to the various methods of health care that were used before the advent of modern medicine. As the term implies, each culture has its own set of traditions for fostering health that have been passed down through the ages. [10]. Despite its long history and many transformations, it continues to provide essential medical care to a significant percentage of the country's population. [11]. Several Asian nations continue to place great importance on traditional medicine. These nations include China, India, Japan, and Pakistan. Herbal plants were the first recognized forms of health products, and their significance continues to rise today.

Advantages of Herbal Medicines [12]

A number of benefits come with using herbal remedies as opposed to pharmaceutical ones. Here are a few illustrations.

Herbal therapies are often more effective than conventional medicine for chronic diseases that have not improved with longer treatment. Natural remedies like herbs have been shown to be effective in the treatment of arthritis. The arthritis medicine Vioxx was recalled due to an increased risk of cardiovascular problems. However, alternative arthritis treatments seldom cause unwanted side effects. Some examples of such therapies include using common herbs, staying away from the nightshade family of vegetables, and consuming less refined sugar.

Herbal treatments also have the benefit of being easily accessible. Herbs can be bought without a prescription. Some easy-to-grow herbs, such as chamomile and peppermint, can be grown in the house. The majority of people in some far-flung regions of the world may only have access to herbs.

Lower cost: One significant advantage of herbal medicine is its low cost. Herbs are significantly less expensive than prescription drugs. Prescription medication costs are significantly inflated due to research, testing, and marketing costs. Herbs, on the other hand, are generally less expensive than pharmaceutical drugs.

Crude Extract More Potent Than Isolated Chemical [13]

In comparison to separate, pure compounds, crude combinations of plant extracts are preferred. The sum of the impacts of a plant's biologically active compounds is greater than the sum of the effects of any individual chemical. It's very uncommon for herbs to have many compounds that work synergistically, making them more effective than the one highly purified substance so beloved by the pharmaceutical industry. Because of their chemical interactions, whole herbs may be more beneficial than their purified component parts [14]. In other words, the whole is bigger than the sum of its parts when various elements are brought together. Synergism occurs when two or more factors interact in a way that produces a multiplicative rather than additive result. Due to the multiplicative nature of the relationship's effects, the end outcome may be many times more significant than the sum of its components. According to the observation, the plant material's numerous synergistic or antagonistic effects may not be fully realized when using one or more separated chemical components in purified forms. Synthesizing the bioactive components would unavoidably reduce or eliminate the benefit [15]. Herbal extracts may help prevent the spread of disease resistance, and bioactive principles may allow us to treat more conditions.

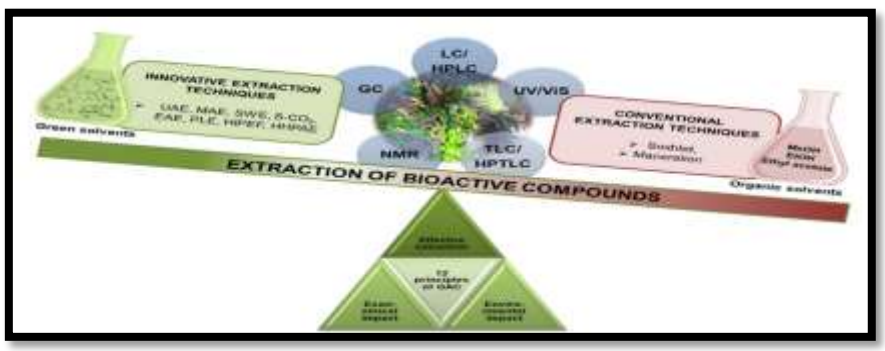


Fig. 1. Crude extract more potent than isolated chemical moiety

Topical Drug Delivery System[16,17]

Topical preparations are an effective means of delivering drugs to specific locations, such as the skin or mucous membranes. This targeted approach is used in the realm of medication delivery systems due to its many advantages. It is worth noting that the drug's efficacy is maintained in topical preparations since they do not undergo first-pass metabolism. They also provide an intravenous therapeutic alternative that is free of the dangers and drawbacks of the conventional method. Problems with absorption, such as enzyme presence, pH fluctuations, and gastric emptying delays, can be avoided with topical treatments. Foams, sprays, powders, solutions, and even adhesive systems that distribute medication topically are all viable alternatives. [18] However, semi-solid formulations are the norm in this industry. Topical drug delivery systems are frequently utilized as a last resort after other methods of drug administration have failed. Furthermore, it plays a significant role in pain management, providing contraception, and treating urinary incontinence.

Table 1: Biological activities of various parts of Allium Cepa L. Plant[19]

S. No.	Plant parts	Activity
1	Whole plant	Rejuvenating, a tonic that supports ageing, Detoxifying, Deobstruent, when blood is vitiated, an antiseptic herb Anaemia, Splenic, and liver growths, jaundice with catarrh, Hyperacidity, Dysentery, gastritis, properties including spasmogenic, hypotensive, and anti-catarrhal
2	Juice of leaves	skin ailments, Allergy-related urticaria, asthma, inflating, colic, and liver disorders, Bronchitis, extra-large glands, Dizziness, Vertigo, fuzzy vision
3	Paste of leaves	Applied over swelling
4	Powder	Bronchitis, Cough, Rheumatism and Skin diseases
5	Decoction	Invigorate the liver, Graying of hair, Bleedings, Spermatorrhoea, Menorrhagia
6	Paste of herb	The healing effect, Headache, Toothache

Table 2. Pharmacological activities of the chemical constituents present in plants[20]

S. No	Chemical constituents	Pharmacological activities
1	Wedelolactone	the antihepatotoxic. Trypsin inhibitors, antivenom, and antibacterial.
2	Eclalbosaponins	Hair revitalizing, Antiproleferative, Antigiardial
3	Demethylwedelolactone	Antihepatotoxic, Antihaemorrhage, Antivenom, Dye (cosmetic)
4	Dasyscyphin C	Antiviral, Anticancer
5	Eclalbatin	Antioxidant
6	Ecliptalbine, verazine	Lipid lowering, Analgesic

An initial investigation

Professor and Head of the Department of Botany at APS University in Rewa, M.P., Dr. S. N. Dwivedi, confirmed that Sesbania grandiflora, Epipacta alba L, and Aloe vera were all harvested from their native environments. These plants have been received by our lab and

labeled as voucher JC/Bot/2019/SEA-626. The Allium cepa L. was also purchased from regional retailers.

Preparation of plant powder[21]

A powder was made from the dried, shade-dried leaves of Eclipta alba L. and the floral parts of Sesbania grandiflora. The powder was sieved through a No. 60 mesh and stored in an airtight container.

Preparation of plant Extracts[22]

For 48 hours at a steady temperature, ethanol solvent was extracted from dried Sesbania grandiflora flowers and Eclipta alba leaves to create a soxhlation. The mass was vacuum dried until it was semisolid. Shred 100 g of allium cepa bulbs, then strain off the impurities and collect the pure extract in a muslin bag. After the inner gel-like pulp of the leaf has been washed, chopped, peeled, and homogenized, the resulting aloe vera extract is a mucilaginous jelly. The parenchyma tissue is then cut away.

Fig.2 Allium cepa L. bulb, Sesbania grandiflora flower, and extract of Eclipta alba (L.)

Table 3 Extractive values of Eclipta alba (L.) flower of Sesbania grandiflora, Allium cepa L[23].

Sr. No.	Plant name	Extractive values (%w/w)
1.	Eclipta alba (L.)	13.12
2.	Sesbania grandiflora	14.5
3.	Allium cepa L.	9.3

Table 4. Phytochemical analysis of Sesbania grandiflora and Allium cepa L. bulb plant leaves and flowers from Eclipta alba (L.)

S.No	Test	Eclipta alba (L.)	Allium cepa L.	Sesbania grandiflora
1.	Alkaloids	+ ve	+ve	+ve
2.	Flavonoids	+ ve	+ ve	+ ve
3.	Steroids	+ ve	+ ve	+ ve
4.	Tannins	+ ve	+ ve	+ ve
5.	Saponins	+ ve	+ ve	+ ve
6.	Carbohydrate	+ve	+ve	+ve
7.	Glycoside	+ve	+ ve	+ ve

(+ Present, - Absent)

Preparation of Polyherbal Gel Containing plant Extract [24,25]

While continuously stirring 50 ml of distilled water, a 1:1 mixture of Carbopol 934 and sodium CMC was dissolved. Propyl and methyl paraben were dissolved in 5 cc of distilled water using a water bath at the appropriate temperatures. After the mixture was at room temperature, 5% propylene glycol by weight was added. The aforementioned polymer mixture was dissolved in 30 ml of ethanol and then mixed with several plant extract combinations. The container was filled to capacity with 100 cc of distilled water. In the end, you'd want to make sure that all of the ingredients were well mixed with the Carbopol 934 gel by swirling constantly. Triethanolamine was progressively added to the formulation (Table 5) in order to produce the desired gel consistency and the skin pH required by the formulation (6.8-7). The identical procedure was used to make the inert sample, minus any plant extracts.

Table 5. Preperation of Polyherbal gel formulations with several plant extracts

Ingredient	**FE_1**	**FE_2**	**FE_3**	**FE_4**	**FE_5**	**FE_6**	**FE_7**	**FA**
Carbopol 934 (gm)	3	3	2	1	1	-	1	1
Sodium CMC (gm)	-	1	1	1	2	3	3	2
Flower extract of *Sesbania grandiflora* (% w/w)	4	4	4	4	4	4	4	4
Leave extract of Eclipta alba (L.) (% w/w)	4	4	4	4	4	4	4	4
Bulb extract of Allium cepa L. (% w/w)	4	4	4	4	4	4	4	4
Tee tree Oil	1 ml	1 ml	1 ml	1 ml	1 ml	1 ml	1 ml	1 ml
Aloe vera	5 ml	5ml	5ml	5ml	5ml	5ml	5ml	5ml
Propylene glycol 400	5	5	5	5	5	5	5	5

(5%)								
Methyl Paraben (0.5%) (ml)	0.3ml	0.3 ml	0.3 ml	0.3 ml	0.3 ml	0.3 ml	0.3 ml	0.3 ml
Propyl Paraben (0.2%) (ml)	5 ml	5 ml	5 ml	5 ml	5 ml	5 ml	5 ml	5 ml
Triethanolamine (ml)	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.	q.s.
Ethanol	-	-	-	-	-	-	-	30 ml
Distilled water (ml)	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml	q.s. to 100ml

*Each formulation contains distilled water up to 100 ml
FE1 to FE7 = Hydrogel, FH = Hydroalcohalic gel

Evaluation of poly herbal Gel Formulation [26]

The final herbal gel had a brownish hue, a translucent appearance, and a smooth, lump-free consistency. There were no detectable changes in FF4's spreadability, pH, or drug content during the accelerated stability testing. The drug concentration, viscosity, pH, and sprinkling ability were also satisfactory. Hence With the help of the hydrogel FF4 formula, a hydroalcohalic gel was made, which was then the subject of a successful physiochemical study.

Table 6: Physical evaluation of all polyherbal gel formulations

Batch	Appearance	Spreadibility (gm.cm/sec)	Consistency (60 mm)	Viscosity (cps)	Ph	Drug content (%)
FE_3	Homogeneous	24.31	8	16952	7.00	99.95
FE_4	Homogeneous	23.77	8	16997	7.00	99.98
FE_5	Homogeneous	24.43	8	16986	7.00	99.97
FA	Homogeneous	23.43	8	16943	7.00	99.98

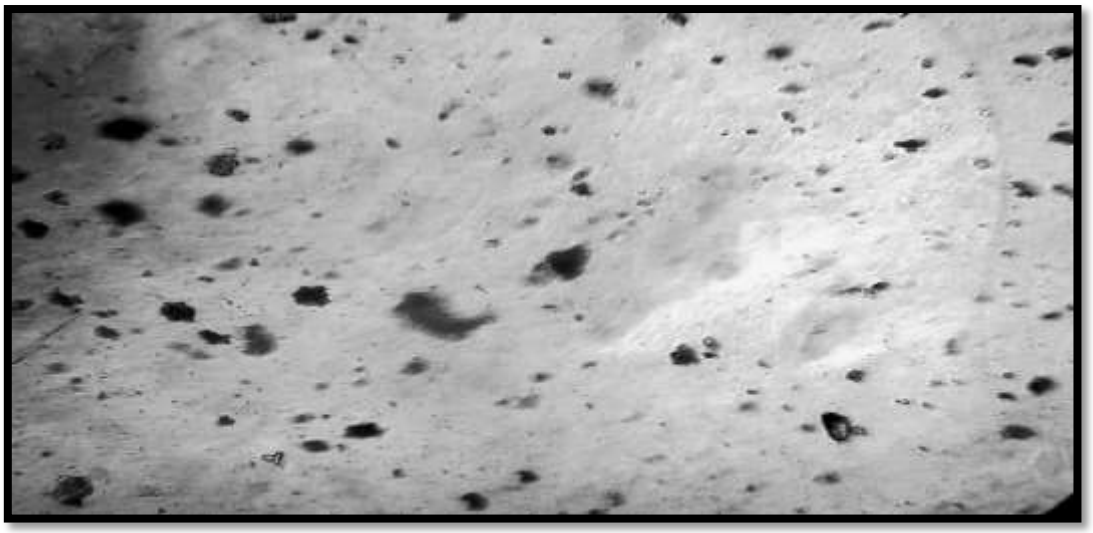


Figure 3. Microscopic photograph's of Polyherbal gel Formulation

In-Vitro Drug Release Studies of polyherbal Gel[27,28]

Drug release from hydroalcoholic gel FE4 and FA formulations including plant combinations was measured at 236 nm and determined to be 25.14 and 29.27 percent after 30 minutes and 57.51 and 64.50 percent after 180 minutes, respectively. Ethanol was found to improve the permeability characteristics of the gel, leading to enhanced release. When compared to other formulations, the hydroalcoholic gel containing both extracts FA showed the highest level of drug release. After 180 mints, both versions released roughly 50% of the medication.

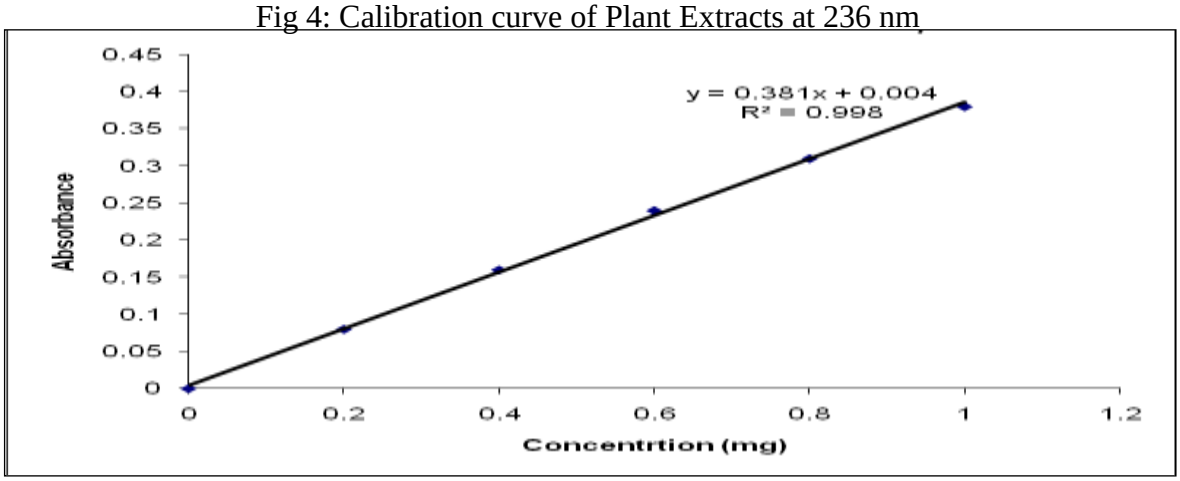
Standard Curve of Plant Extract[29]

By comparing absorbance at 236 nm to concentration, scientists produced the standard calibration curve for plant extracts. The standard curve for the herbal extract is depicted in Fig. 1 and Table No. 3. Beer's law limit was met between 2 and 12 mcg/ml using this method (at 234 nm), with a regression value of 0.998.

Table 7: Plant extract calibration curve at 236 nm

S.No	Concentration (µg/ml)	Absorbance
1.	Blank	0.000
2.	0.2	0.082
3.	0.4	0.163
4.	0.6	0.242
5.	0.8	0.314
6.	1.0	0.383

Fig 4: Calibration curve of Plant Extracts at 236 nm



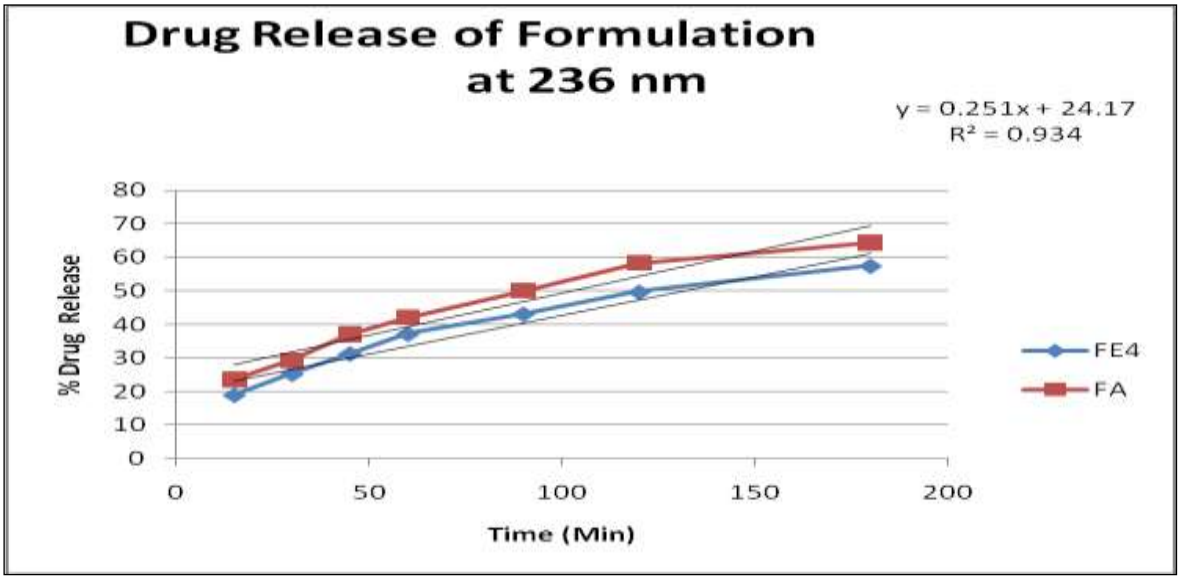


Fig 5: Percent Drug Release of Formulation at 236 nm

Pharmacological Screening of Optimized Formulation [32,33]

An enhanced formulation containing HA-containing plant extract was used in an in-vivo hair growth investigation. Quantitative and qualitative evidence of hair development was present. A qualitative analysis of hair growth was performed by visually noting two variables: when hair growth began and when it ended. Hair growth can be measured in a number of ways, including through histological examinations, hair weight, and hair length.

Qualitative Evaluation of In-Vivo Hair Growth[34]

Animals given a herbal treatment comprising a combination of extracts grew hair more slowly than those given either a placebo or minoxidil. (Table 1). The mice treated with minoxidil as a control group and those given a test formulation including a plant extract also started growing hair after the first week. In a similar vein, the minoxidil therapy and formulation FA sped up the whole hair growth process in previously shaven areas. Formulation and minoxidil lead to complete hair growth. The FA group was followed for a total of 23 and 24 days.

Qualitative Hair Growth Observation [35]

Table 8 Effect of Extracts on the Duration and Rate of Hair Growth

Group	Treatment	Time taken to initiate the growth (in days)	Time taken for complete growth (in days)
Group I	Control	13±0.70	35.20±1.23
Group II	2% Minoxidil	6.08±0.81	23.8±0.73
Group III	Extract combination (PE2)	8.56±64	26.4±0.61
Group IV	Hydroalcoholic Gel	6.85±0.61	24.1±0.21

Values are mean ± SEM

2. Result and Discussion

In the current investigation, a specific herbal plant was used to produce, define, and assess a topical treatment system for the management of alopecia. Formulations for Eclipta alba (L.) leaves, Allium cepa bulbs, Sesbania grandiflora flowers, hydrogel, and hydroalcoholic gels were all developed and improved using aloe vera. The plant species being investigated can be precisely identified using physical-chemical analytical investigations as a diagnostic tool. The efficacy and purity of the selected plant will therefore be improved by using these standardization metrics to identify adulterants, if any, in the plant. These discoveries can all be used to determine the precise identification, identity, and purity of the chosen endangered plant.. Investigated was the existence of various medicinally beneficial components in the extracts. Alkaloids, tannins, terpenoids, polysaccharides, glycosides, saponins, protein, and flavonoids are the main active components of ethanolic extract, according to physicochemical investigations. Both Aloe vera and Allium cepa L. produced unique extractions. The evidence is compelling in favor of treating alopecia using a plant-based remedy. As a result, the plant might be used as an alternative to traditional treatments for alopecia. Using different amounts of Carbopol and sodium CMC polymer, the hydrogel and hydroalcoholic gel formulation of the hydroalcoholic extract combination PE2 was created. The concentrations of the excipients Carbopol and sodium CMC were gradually increased and subsequently lowered during the course of the experiment as different problems with homogeneity, spreadability, and viscosity were identified. After some batches were eliminated due to uniformity, the remaining batches (FE3, FE4, and FE5) were characterized a variety of parameters. According to the findings, the herbal gel that had been created was translucent in appearance, greenish in color, and homogeneous without lumps. Spreadability, viscosity, pH, drug content, and results from accelerated stability studies all showed that formulation FE5 was a good choice. medical evaluation of a better formulation According to an FA study, rats fed the mixture had considerably speedier times for both the start and finish of their hair growth. On day six, new hair growth could be seen. Similar to this, the shaved area's hair took 24 days to fully regrow. The combination Hydroalcoholic gel FA extract demonstrated 2.64 mm of hair growth after 30 days. Polyherbal Gels were subjected to stability testing. It was unable to see any color fading for any of the produced gels. The pH values of all formulations remained steady and ranged from 6.2 to 7.2. The spreadability and viscosity of all gels remained unchanged and were determined to be within the permitted range. The drug content was found to be within the permitted range of 90% to 100% for all gel formulations and temperatures. Stability studies revealed that everything was optimized. Combinations of extracts in formulations are stable and may be thought of for commercialisation. The herbo-cosmeceutical formulation is more effective, safe, active, and free of side effects when compared to commercial cosmeceuticals. The current research aims to develop herbal cosmeceutical formulations that can satisfy consumer needs.

3. Reference

1. Ohîi, C.; Blebea, N. M. Authorization Procedure for Medicines from Medicinal Plants with Traditional Use. *Farmacist.ro*, **2023**, *2* (211), 21.
2. Amin, M. N. Characterization of Phytochemicals and Determination of Antioxidant, Antimicrobial and Cytotoxic Properties of the Medicinal Plant Ardisia Solanacea. *Discovery Phytomedicine - Journal of Natural Products Research and Ethnopharmacology*, **2023**, *9* (2)..

3. A Review on Phyto Chemical, Antimicrobial and Antioxidant Properties in Medicinal Plant Oxystelma Esculentum R. Br. *International Journal of Green and Herbal Chemistry*, **2023**, *12* (1). .
4. Sharma, R. K.; Singh, N.; Kushwah, A. S.; Kumar, M. Therapeutic Potential of Indian Medicinal Herbs and Current Therapeutic Approach Used to Mitigate the Symptoms of Chronic Fatigue Syndrome: A Review. *Current Traditional Medicine*, **2023**, *10*.
5. Ndoumba-Mintya, A.; Diallo, Y. L.; Tayou, T. C.; Mbanya, D. N. Optimizing Haemophilia Care in Resource-Limited Countries: Current Challenges and Future Prospects. *Journal of Blood Medicine*, **2023**, *Volume 14*, 141–146.
6. Huang, Y.; Peng, H.; Zeng, A.; Song, L. The Role of Peptides in Reversing Chemoresistance of Breast Cancer: Current Facts and Future Prospects. *Frontiers in Pharmacology*, **2023**, *14*.
7. Singh, Dr. M. Role of Plants in Different Religious Ceremonies Common to Uttarakhand Region. *International Journal of Ayurveda and Herbal Research (IJAHR)*, **2023**, *1* (1), 19–22.
8. Karbasi, N.; Najminouri, F.; Sadrabad, M. J.; Raeiszadeh, M. Oral Ulcerative Disease: A Systematic Review of Herbal Medicine Treatments. *Journal of Herbal Medicine*, **2023**, *40*, 100681.
9. Duraisamy, P.; Ravi, S.; Krishnan, M.; Martin, L. C.; Manikandan, B.; Raman, T.; Munusamy, A.; Ramar, M. Scoparia Dulcis and Indigofera Tinctoria as Potential Herbal Remedies against 7-Ketocholesterol-Induced pro-Inflammatory Mediators of Macrophage Polarization. *Journal of Herbal Medicine*, **2023**, *39*, 100652.
10. Thandi, C. S.; Constantinou, S.; Vincent, R.; Ridd, M. J. Where and How Have Written Action Plans for Atopic Eczema/Dermatitis Been Developed and Evaluated? Systematic Review. *Skin Health and Disease*, **2023**, *3* (3).
11. Tenkorang, E. Y. Understanding Sibling Violence and Its Impact over the Life Course: The Case of Ghana. *Advances in Life Course Research*, **2023**, *57*, 100564.
12. Li, W. Contents and Significance of Secondary Development of Large Varieties of Traditional Chinese Medicines. *Chinese Herbal Medicines*, **2023**, *15* (2), 155–156.
13. Yue, J.; Sun, X.; Duan, X.; Sun, C.; Chen, H.; Sun, H.; Zhang, L. Triphenyl Phosphate Proved More Potent than Its Metabolite Diphenyl Phosphate in Inducing Hepatic Insulin Resistance through Endoplasmic Reticulum Stress. *Environment International*, **2023**, *172*, 107749.
14. Pacholko, A. G.; Bekar, L. K. Different Pharmacokinetics of Lithium Orotate Inform Why It Is More Potent, Effective, and Less Toxic than Lithium Carbonate in a Mouse Model of Mania. *Journal of Psychiatric Research*, **2023**, *164*, 192–201.
15. Gutte, R.; Deshmukh, V. A Comprehensive Review of the Preventive Action of Natural Nutraceutical Ingredients in Reducing Chemotherapy – Induced Side Effects. *Functional Food Science*, **2023**, *3* (2), 1.
16. Billowria, K.; Sandhu, N. K.; Singh, B. Topical Advances in Mucoadhesive Ocular Drug Delivery System. *Current Drug Delivery*, **2023**, *20* (8), 1127–1140.
17. Emulgel-Novel Topical Drug Delivery System. *NeuroQuantology*, **2023**, *20* (17).
18. da Silva, J. B.; dos Santos, R. S.; Vecchi, C. F.; da Silva Souza Campanholi, K.; da Silva Junior, R. C.; de Castro Hoshino, L. V.; Caetano, W.; Baesso, M. L.; Simas, F. F.; Cook, M. T.; et al. Boosting the Photodynamic Activity of Erythrosine B by Using Thermoresponsive and Adhesive Systems Containing Cellulose Derivatives for Topical Delivery. *International Journal of Biological Macromolecules*, **2023**, *245*, 125491..

19. Tkachuk, N.; Zelena, L. ONION (ALLIUM CEPA L.) AS A TEST PLANT. *Biota. Human. Technology*, **2023**, No. 3, 50–59.
20. Dina, D. T.; Isnawati, N. The Antibacterial Activities of Shallot (Allium Cepa) and Garlic (Allium Sativum) Skin Extracts. *International Journal of Pharmaceutical and Bio-Medical Science*, **2023**, *03* (06).
21. PPG Completes US$15M Expansion of Indiana Powder Coatings Plant. *Focus on Powder Coatings*, **2023**, *2023* (6), 3.
22. Muntean, D.; Vulpie, S. Antioxidant and Antibacterial Activity of Plant Extracts. *Antibiotics*, **2023**, *12* (7), 1176.
23. Gobinath, E.; Dhatchinamoorthy, M.; Saran, P.; Vishnu, D.; Indumathy, R.; Kalaiarasi, G. Synthesis and Characterization of NiO Nanoparticles Using Sesbania Grandiflora Flower to Evaluate Cytotoxicity. *Results in Chemistry*, **2023**, *6*, 101043.
24. Baitule, A. W. Antiinflammatory Activity of Polyherbal Gel Formulation. *International Journal of Current Science Research and Review*, **2023**, *06* (03).
25. Yadav, A.; Ratre, M. Development of Anti-Acne Topical Gel Formulation Containing Herbal Extract. *International Journal of Medical & Pharmaceutical Sciences*, **2023**, *13* (03), 11–16.
26. FORMULATION AND EVALUATION OF HERBAL SUNSCREEN GEL CONTAINING CARROT SEED OIL. *International Research Journal of Modernization in Engineering Technology and Science*, **2023**.
27. Baitule, A. W. Antiinflammatory Activity of Polyherbal Gel Formulation. *International Journal of Current Science Research and Review*, **2023**, *06* (03).
28. Rohini Sharma , Dharmendra Ahuja. Formulation And Evaluation Polyherbal Gel Against Staphylococcus Aureus Bacteria Causing Skin Disease. *Journal of Pharmaceutical Negative Results*, **2022**, 4489–4495.
29. Hair Loss - From Tight Hair Style. *Pediatric Patient Education*, **2023**.
30. Natarelli, N.; Gahoonia, N.; Sivamani, R. K. Integrative and Mechanistic Approach to the Hair Growth Cycle and Hair Loss. *Journal of Clinical Medicine*, **2023**, *12* (3), 893.
31. Makhlouf, A.; Elnawawy, T. Hair Regrowth Boosting via Minoxidil Cubosomes: Formulation Development, in Vivo Hair Regrowth Evaluation, Histopathological Examination and Confocal Laser Microscopy Imaging. *International Journal of Pharmaceutics*, **2023**, *634*, 122665.
32. J K, P.; MK, S.; PS, S.; BG, C. In-Vivo Studies to Determine Hair Growth Potential of Poly Herbal Medicated Hair Oil in Female Swiss Albino Mice. *Research Journal of Pharmacy and Technology*, **2023**, 1409–1414.
33. Makhlouf, A.; Elnawawy, T. Hair Regrowth Boosting via Minoxidil Cubosomes: Formulation Development, in Vivo Hair Regrowth Evaluation, Histopathological Examination and Confocal Laser Microscopy Imaging. *International Journal of Pharmaceutics*, **2023**, *634*, 122665.
34. Kang, S.-J.; Kim, J.-E. Development of Clinically Optimized Sitagliptin and Dapagliflozin Complex Tablets: Pre-Formulation, Formulation, and Human Bioequivalence Studies. *Pharmaceutics*, **2023**, *15* (4), 1246.
35. Performance of optimized formulation in vitro and in vivo for effective delivery. *International Journal of Early Childhood Special Education*, **2023**, *12* (1).
36. Antioxidant and healing properties of the extract glycyrrhiza glabra. *Plant & fungal research*, **2023**.
37. Mudgil, M., & Pawar, P. K. (2013). Preparation and In Vitro/Ex Vivo Evaluation of Moxifloxacin-Loaded PLGA Nanosuspensions for Ophthalmic Application. Scientia pharmaceutica, 81(2), 591–606. https://doi.org/10.3797/scipharm.1204-16 Behl, T.,

Bungau, S., Kumar, K., Zengin, G., Khan, F., Kumar, A., Kaur, R., Venkatachalam, T., Tit, D. M., Vesa, C. M., Barsan, G., & Mosteanu, D. E. (2020). Pleotropic Effects of Polyphenols in Cardiovascular System. Biomedicine & pharmacotherapy = Biomedecine & pharmacotherapie, 130, 110714. https://doi.org/10.1016/j.biopha.2020.110714

38. Behl, T., Bungau, S., Kumar, K., Zengin, G., Khan, F., Kumar, A., Kaur, R., Venkatachalam, T., Tit, D. M., Vesa, C. M., Barsan, G., & Mosteanu, D. E. (2020). Pleotropic Effects of Polyphenols in Cardiovascular System. Biomedicine & pharmacotherapy = Biomedecine & pharmacotherapie, 130, 110714. https://doi.org/10.1016/j.biopha.2020.110714