

Formulation and Evaluation of Anti Dandruff Shampoo of *Coccinia grandis* leaf

Vijaya Verma^{1,*}, Ritu Sahu¹, Shobha Nirmalkar¹, Vaibhav Kumar Sahu¹, Shashi Kodopi¹, Amrit Lal Verma¹

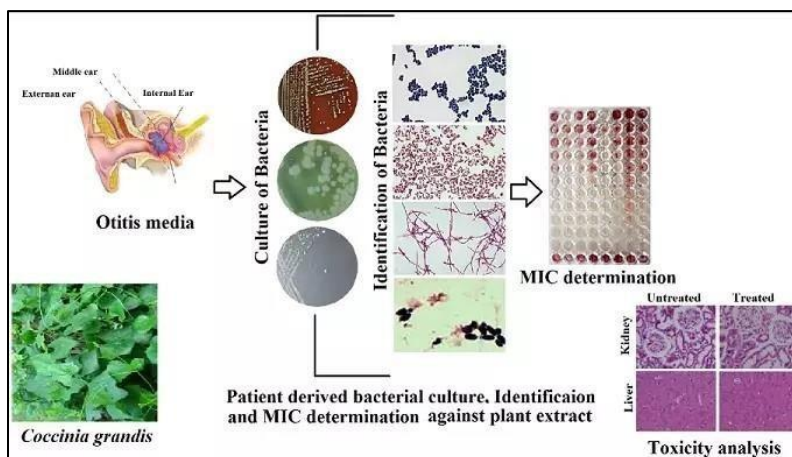
^{1,*}Apollo College of Pharmacy in Anjora, Durg - 491001. Chhattisgarh, India

* Correspondence: vijayaverma958@gmail.com
<https://doi.org/10.5281/zenodo.20488869>

Abstract:

Dandruff is a common scalp disorder characterized by excessive scaling, itching, and irritation. Herbal formulations are increasingly preferred due to their safety, biocompatibility, and minimal side effects. The present study aimed to formulate and evaluate a polyherbal antidandruff shampoo incorporating *Coccinia grandis* leaf extract, which is known for its antimicrobial, anti-inflammatory, and antioxidant properties. The experimental assessment of antifungal agents revealed that both 1% Ketoconazole and 1% *Coccinia grandis* extract exhibited potent antifungal activity, each demonstrating a minimum inhibitory concentration (MIC) of 0.6 mm. These findings indicate that *Coccinia grandis* extract possesses antifungal efficacy comparable to that of the established synthetic antifungal agent, Ketoconazole, in inhibiting fungal growth. In contrast, 1% extracts of “Common” and “Carrom” showed significantly weaker antifungal activity, with a higher MIC value of 8 mm. Distilled water, used as a negative control, showed no antifungal activity, thereby confirming the validity of the observed inhibition results. These observations suggest that *Coccinia grandis* may serve as a promising natural source for the development of novel antifungal compounds. The shampoo formulation was prepared using standard cosmetic formulation techniques, including the preparation of an aqueous herbal extract, incorporation into a surfactant-based shampoo base, and the addition of stabilizers, preservatives, and fragrance agents. The formulated shampoo was further evaluated for various physicochemical parameters such as pH, viscosity, foamability, spreadability, and stability, along with its antidandruff activity against fungal strains commonly associated with dandruff.

Graphical Abstract:



Keywords: *Coccinia grandis*, polyherbal shampoo, antidandruff, antifungal, herbal formulation

Aim:

To formulate a polyherbal antidandruff shampoo incorporating *Coccinia grandis* leaf extract and to evaluate its physicochemical properties, stability, and antifungal activity against dandruff-causing microorganisms, in order to develop a safe, effective, and herbal alternative to conventional chemical shampoos.

Objective:

OBJECTIVE-1

- Phytochemical investigation of *coccinia grandis*.
- Formulation and evaluation of herbal shampoo

Introduction:

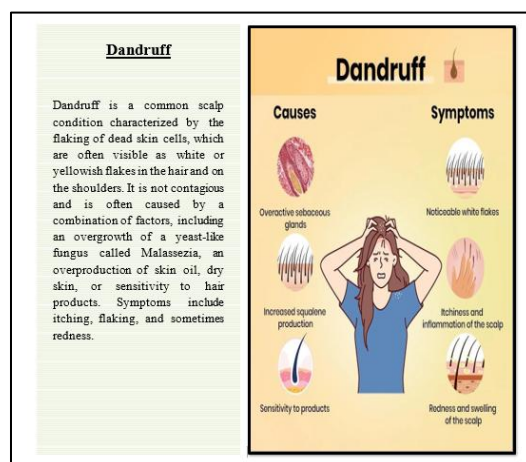
Coccinia grandis, commonly known as Ivy gourd, belongs to the Cucurbitaceae family. It is widely distributed in several countries, including India, Bangladesh, Pakistan. And it has various medicinal uses. The leaves of this plant are the most valued part, shaped like hearts.

Phytochemical analysis has revealed the presence of several bioactive compounds, including alkaloids, flavonoids, saponins, phenols, and glycosides. These constituents contribute to the plant's wide range of pharmacological activities, such as anti-diabetic, anti-inflammatory, anti- microbial, wound healing and antioxidant effects.



Fig. 1: *Coccinia grandis* plant.

1. **Botanical name:** *Coccinia grandis*
2. **Family:** Cucurbitaceae
3. **Chemical constituents in ivy gourd leaves:** Ivy gourd (*Coccinia grandis*) leaves contain various chemical constituents, including alkaloids, flavonoids, glycosides, saponins, and steroids. Other compounds found in the leaves include amino acids, carbohydrates, tannins, and phenols.





Anti-dandruff activity -

Herbal anti-dandruff treatment involves using natural ingredients like neem, fenugreek, tea tree oil, and aloe vera due to their antifungal, antibacterial, and anti-inflammatory properties.

The same properties available in the *Coccinia grandis*

2. Materials and Methods

1. Selection of plant material:

Ivy gourd leaves, *coccinia grandis* (kundru) are used for this study is collected from Rajnandgaon market of Chhattisgarh state and was authenticated from department of botany, GOVT.T.V.Y. PG. Autonomous college, Durg (C.G.).

2. Macroscopic Evaluation:

For the macroscopic evaluation of leaves of *coccinia grandis*. Firstly the collected Leaves were clean with the water & surface was dried gently by using tissue paper. The color, odour, size, shape & texture were examined.

3. Extractive value:

Extractive value of crude drug are useful for their evaluation, these values indicate the nature of constituents present in a *coccinia grandis*.

4. Extraction of dried leaves using different solvent:

The collected *Coccinia grandis* leaves were dried. Further it was subjected to pulverization to coarse powder and successively extracted with solvent by filtrated method. Polarity index of some solvents.

5. Determination of Foaming Index:

After confirmation of presence of spooning glycosides by preliminary phytochemical screening. the foaming index was determined. Weight accurately about 1gm of coarsely powdered drug and transferred to 500ml conical flask containing 100ml of boiling water maintain a moderate boiling at 80-90 c temperature for about 30 min. then make it cold, filter in to volumetric flask. Cleaned test tube 10 no. are taken and marked with 1-10... take the successive portions of 1,2ml up to 10ml drug in separate tubes and adjust remaining volume with the liquid up to 10ml in each test tube. After closing the tubes with stoppers, shake them for 15 sec. and allowed to stand for 15mint. Then measure the height. If the height of foam in every test tube is less than 1cm then foaming index become less than 100 it is more than 1cm in every test tube then it will be over 1000, if the height of the foam in any 1 test tube becomes 1cm, then following formula was used for determination of foaming index.

Formula: $1000 - a$ (a volume of powdered drug decoction in the test tube showing 1cm height)

6. Determination of Swelling Index:

Many herbal drugs are of specified for the therapeutic or pharmaceutical utility because of their swelling properties and drugs those are containing an appreciable amount of constituents like mucilage, Pectin or hemicelluloses. The swelling index in is defined as the volume in ml taken up by the swelling of 1gm of herbal material under specified condition. Its determination on the addition of water or a swelling agent as specified in the test procedure for each individual herbal material.



3. Invitro Antidandruff study

The antimicrobial assay was carried out using agar well diffusion method in brief. The first step is to wash your hands and then wipe down your bench with 20% of ethanol.

Step –

The sterilized nutrient agar medium plates were spread with fungal suspension (10^6 CFU), prepared in sterile water, using sterile glass spreader.



Further, the holes were punched using sterile cork borer and volume of 50 μ L extract prepared in sterile water was filled in each bore.



Here, sterile water was used as control.



The plates were incubated at 30–35°C for 7–8 days for *Malassezia globosa*.



The minimum inhibitory concentration (MIC) represents the lowest concentration of substance as an antimicrobial, that can inhibit the visible growth of microorganism after overnight incubation.



In order to determine the MIC's of extracts, the initial extract concentration of 50 mg/mL were evaluated for growth inhibition. Further, those extract showed inhibition zone were checked for lower concentration while the concentration were increased for not showing visible inhibition zone. Overall, for the MIC's of extract, the concentration used were in the range of 10–100 mg/mL. The experiment was repeated thrice and diameter of inhibition zone, in mm, by respective extract was noted down as mean $\pm$ standard deviation.

4. Formulation and evaluation of polyhedral shampoo

Polyhedral shampoos are formulated using natural plant extracts and powder (e.g., Amla, fenugreek) to provide natural hair cleansing, conditioning, and anti-dandruff benefits without harsh chemicals. Key steps include decoction of herbs, filtering, and mixing with surfactants (often natural saponins).

Formulation Process –

- **Collection and Preparation:** Fresh or dried plant materials are collected, washed, dried, and reduced to a coarse powder.
- **Extraction (Decoction Method):** Individual or mixed herb powders (Fenugreek, Amla, etc.) are used for preparation of the extract.
- **Thickening and Homogenization:** A guar gum solution is mixed into the herbal extract to achieve a viscous, gel-like texture. The ingredients are stirred on a magnetic stirrer for 15–20 minutes to ensure a uniform mixture.
- **Addition of Actives and Preservatives:** Additional ingredients like Aloe vera gel, lemon juice, or essential oils (fragrance) are added to the mixture.
- **Final Formulation and Packaging:** The mixture is filtered again if necessary and filled into sterilized containers.



Formulation Table-

S. No.	Ingredient	Quantity
1	SLS	4.5 ml
2	Glycerin	0.1 ml
3	NaCl	0.1 ml
4	sodium Benzoate	0.2 gm
5	citric Acid	0.5 gm
6	Amla	7.0 gm
7	Fenugreek	7.0 gm
8	Sandalwood	1.0 gm
9	Coccinia Grandis	5.0 gm
10	Distilled Water	Q.S to 50 ml

4. Results and Discussion

Antidandruff shampoo incorporating *Coccinia grandis* leaf extract and to evaluate its physicochemical properties, stability, and antidandruff activity has been studied. The study successfully demonstrated that ***Coccinia grandis* extract can be incorporated into a polyherbal shampoo** with desirable cosmetic and therapeutic qualities.

1. Antidandruff Effectiveness

The antifungal test confirmed that the shampoo had measurable inhibitory activity against dandruff-causing fungi.

2. Synergistic Action of Polyherbal Ingredients

- Flavonoids
- Saponins
- Alkaloids
- Phenolic compounds

3. Cosmetic Acceptability

The shampoo exhibited:

- Good foamability
- Stable viscosity
- Uniform appearance

The results of the research work and its related discussion are given step-wise as below:

- Selection of plant materials
- Physicochemical studies –
 - Determination of Loss on Drying
 - Determination of Extractive Value
 - Determination of Foaming Index
 - Determination of Swelling Index
- Extraction of dried seeds using different solvents
- In-vitro studies of extracts
- Antidandruff study

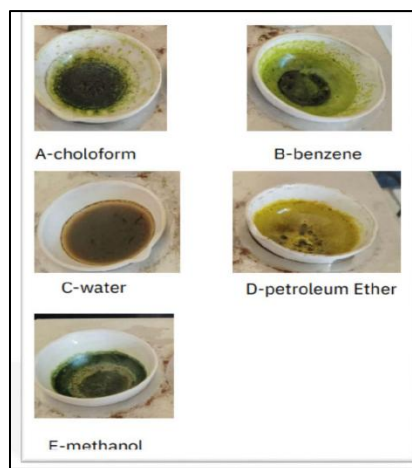


Fig. 2: Extractive Value

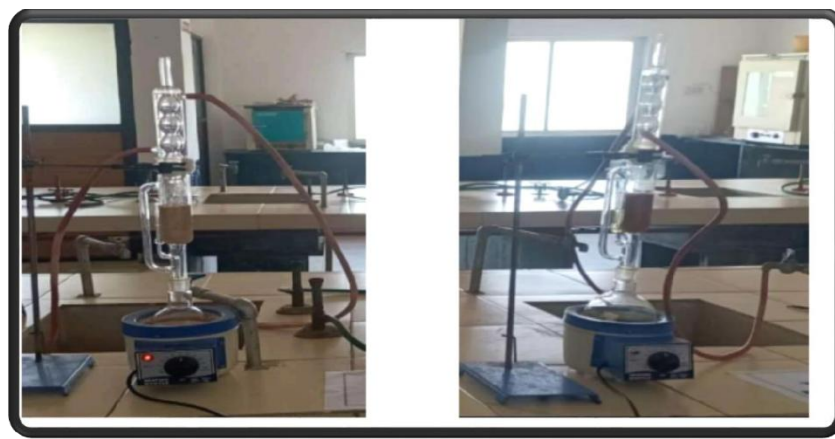


Fig. 3: Extractive Process



Fig. 4: Foaming Index

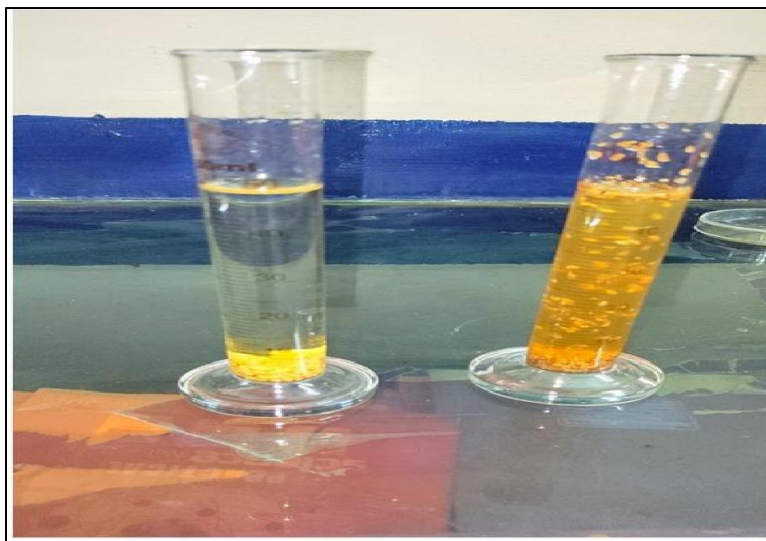
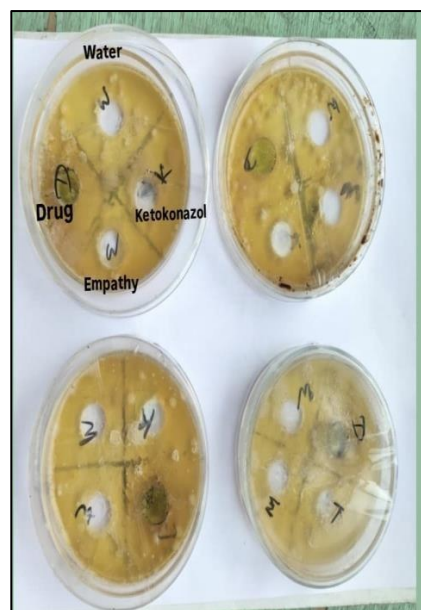
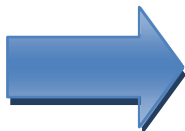


Fig. 5: Swelling Index



A: Preparation of culture media **B:** Apply the Drug (sample), Ketokonazol (standard), Empathy, Water



C: - Petri plate

D: - Inhibition Zone



(A) Ingredients



(B) Weight the ingredient



(C) Take ingredient in small beaker



(D) Mix the all ingredients



(E) Formulation



(F) Formulation of Anti-dandruff shampoo



(G) Preparation of shampoo



(H) Storage and packaging of shampoo

S NO.	SOLVENT	EXTRACTIVE VALUE
1	Benzene	0.19 gm
2	Methanol	0.27 gm
3	Water	0.28 gm
4	Chloroform	1.38 gm
5	Petrolia Ether	0.4 gm



Physical Evaluation-

S. No.	Evaluation parameter	Method / apparatus	Result / Observation
1	Color	Visual Inspection	Greenish-brown
2	Odor	Olfactory	(Herbal/Sandalwood)
3	Appearance	Visual Inspection	Viscous, smooth
4	Spreadability	Glass Slide & Weight Method	(Spreads easily)
5	Foam Height	(Initial) Cylinder Shake Method	45 mm
6	Foam Retention	(5 mins) Cylinder Shake Method	38 mm
7	Wetting Time	Canvas Disk Method	18 seconds
8	Swelling Index	Stoppard Cylinder (24 hrs)	2.8 ml

Evaluation Of Antidandruff Activity

Drug Name	Concentration of drug	MIC
Petri plate 1		
Ketoconazole	1%	0.6mm
Coccinia grandis	1%	0.6mm
Common	1 %	8 mm
Distilled water	-	-
Petri plate 2		
Ketoconazole	1%	0.6mm
Coccinia grandis	1%	0.6mm
Carrom	1%	8 mm
Distilled water	-	-



1. Ketoconazole: The synthetic antifungal drug Ketoconazole, at a 1% concentration, consistently demonstrated a potent inhibitory effect on fungal growth, evidenced by a Minimal Inhibitory Concentration (MIC) of 0.6 mm in both Petri plate experiments. This low MIC value indicates high antifungal efficacy, suggesting that Ketoconazole effectively impedes fungal proliferation even at a relatively dilute concentration. Its established mechanism of action, involving the inhibition of ergosterol synthesis, likely contributes to this observed effectiveness.

2. Coccinia grandis (Ivy Gourd) Extract: Similar to Ketoconazole, the Coccinia grandis extract at a 1% concentration also exhibited a low MIC of 0.6 mm across both experimental setups. This suggests that the Coccinia grandis extract possesses significant antifungal properties comparable to a conventional antifungal agent. The phytochemical compounds present in Coccinia grandis, such as alkaloids, flavonoids, and glycosides, are likely responsible for these fungicidal or fungistatic effects. Its consistent performance across two plates highlights its potential as a natural source of antifungal agents.

3. Common/Carrom Extract: The extracts labeled "Common" (in Petri plate 1) and "Carrom" (in Petri plate 2), both at a 1% concentration, showed a considerably higher MIC of 8 mm. This indicates a much weaker antifungal activity compared to Ketoconazole and Coccinia grandis. A larger zone of inhibition (MIC) signifies that a greater concentration or quantity of the substance is required to inhibit fungal growth effectively. The active compounds in "Common" and "Carrom" extracts, while potentially having some bioactivity, do not appear to confer strong antifungal properties at the tested concentration. The identical MIC values across both plates for these similarly named or potentially identical samples suggest a consistent, albeit limited, antifungal profile.

4. Distilled Water (Negative Control): As expected, distilled water, serving as a negative control, did not exhibit any antifungal activity. The absence of an MIC value for distilled water confirms that the observed inhibitory effects from the other tested substances were due to their intrinsic properties and not other experimental factors. Distilled water ensures a baseline for comparison, confirming the validity of the experimental setup by demonstrating no inherent effect on fungal growth.

The consistent results across Petri plates 1 and 2 for Ketoconazole and Coccinia grandis reinforce the reliability of these findings. The marked difference in MIC values between these two substances and the "Common/Carrom" extracts highlights a clear disparity in their antifungal potential.

5. Summery And Conclusion

- The polyherbal antidandruff shampoo containing Coccinia grandis was successfully formulated and exhibited significant antifungal activity, good stability, and acceptable physicochemical properties. The results support the potential of Coccinia grandis as a natural ingredient in herbal hair-care formulations for dandruff management. The physical evaluation and extractive value analysis of the formulation revealed satisfactory physicochemical characteristics and stability. Among the different solvents used for extractive value determination, chloroform showed the highest extractive value (1.38 g), indicating the presence of a greater amount of chloroform-soluble constituents, whereas benzene showed the lowest extractive value (0.19 g). Methanol, water, and petroleum ether exhibited moderate extractive values of 0.27 g, 0.28 g, and 0.40 g respectively, suggesting the presence of both polar and non-polar phytoconstituents in the sample.

- The formulation appeared greenish-brown in color with a pleasant herbal/sandalwood odor and exhibited a viscous, smooth consistency, indicating acceptable aesthetic and organoleptic properties. The spreadability study demonstrated that the formulation spreads easily, which may facilitate convenient application. Foam analysis showed an initial foam height of 45 mm with good foam retention of 38 mm after 5 minutes, indicating satisfactory foaming ability and stability. The wetting time was found to be 18 seconds, suggesting efficient wetting characteristics. The swelling index was recorded as 2.8 ml after 24 hours, indicating moderate swelling behavior and good hydration capacity of the formulation.



- Overall, the evaluated parameters suggest that the formulation possesses acceptable physical characteristics, stability, and performance suitable for further pharmaceutical or cosmetic applications
- The experimental assessment of antifungal agents revealed that both a 1% concentration of Ketoconazole and a 1% extract of *Coccinia grandis* demonstrated potent antifungal activity, each achieving a minimal inhibitory concentration (MIC) of 0.6 mm. This indicates that *Coccinia grandis* extract possesses comparable efficacy to the established synthetic antifungal drug, Ketoconazole, in inhibiting fungal growth. In contrast, 1% extracts of "Common" and "Carrom" exhibited significantly weaker antifungal properties, with a much higher MIC of 8 mm. Distilled water, used as a negative control, showed no antifungal activity, confirming the validity of the observed inhibitions. These findings suggest that *Coccinia grandis* holds promise as a natural source for novel antifungal compounds.

References:

- [1] American Diabetes Association (2010). Diagnosis and classification of diabetes mellitus. *Diabetes Care*, 33(1): S62–S69.
- [2] Blois MS (1958). Antioxidant determinations by the use of a stable free radical. *Nature*, 181: 1199–1200.
- [3] Chang CC, Yang MH, Wen HM, Chern JC (2002). Estimation of total flavonoid content in propolis by two complementary colorimetric methods. *Journal of Food and Drug Analysis*, 10(3): 178–182.
- [4] Chaudhry PS, Cabrera J, Juliani HR, Varma SD (1983). Inhibition of human lens aldose reductase by flavonoids, sulindac and indomethacin. *Biochemical Pharmacology*, 32(13): 1995–1998.
- [5] Singleton VL, Orthofer R, Lamuela-Raventos RM (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin–Ciocalteu reagent. In: Packer L (Ed.), *Methods in Enzymology*. Elsevier, Amsterdam, pp. 152–178.
- [6] Rao GMM, Vijayakumar M, Rao CV, Rawat AKS, Mehrotra S (2003). Hepatoprotective effect of *Coccinia indica* against CCl₄ induced hepatotoxicity. *Natural Product Sciences*, 9(1): 13–17.
- [7] Meenatchi P, Purushothaman A, Maneemegalai S (2017). Antioxidant, antiglycation and insulinotrophic properties of *Coccinia grandis* (L.) in vitro: possible role in prevention of diabetic complications. *Journal of Traditional and Complementary Medicine*, 7(1): 54–64.
- [8] Li J, Tian YZ, Sun BY, Yang D, Chen JP, Men QM (2012). Analysis on volatile constituents in leaves and fruits of *Ficus carica* by GC–MS. *Chinese Herbal Medicines*, 4(1): 63–69.
- [9] Singleton VL, Orthofer R, Lamuela-Raventos RM (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin–Ciocalteu reagent. In: Packer L (Ed.), *Methods in Enzymology*. Elsevier, Amsterdam, pp. 152–178.
- [10] Umamaheswari M, Chatterjee TK (2008). In vitro antioxidant activities of the fractions of *Coccinia grandis* L. leaf extract. *African Journal of Traditional, Complementary and Alternative Medicines*, 5(1): 61–73.
- [11] Wei LS, Wee W, Siong JY, Syamsumir DF (2011). Characterization of anticancer, antimicrobial, antioxidant properties and chemical compositions of *Peperomia pellucida* leaf extract. *Acta Medica Iranica*, 49(10): 670–674.



- [12] Wasantwisut E, Viriyapanich T (2003). Ivy gourd (*Coccinia grandis* Voigt, *Coccinia cordifolia*, *Coccinia indica*) in human nutrition and traditional applications. *World Review of Nutrition and Dietetics*, 91: 60–66.
- [13] Vaishnav MM, Jain P, Jogi SR, Gupta KR (2001). Coccinioside-K, triterpenoid saponin from *Coccinia indica*. *Oriental Journal of Chemistry*, 17(3): 465–468.
- [14] Saleem U, et al. (2014). Physicochemical and phytochemical analysis of *Euphorbia helioscopia* (L.). *Pakistan Journal of Pharmaceutical Sciences*, 27(3).
- [15] Onlom C, et al. (2014). In vitro anti-*Malassezia* activity and potential use in anti-dandruff formulation of *Asparagus racemosus*. *International Journal of Cosmetic Science*, 36(1): 74–78.
- [16] Anwar R, Abd us Sattar A, Ashiq K (2022). Amelioration of streptozotocin-induced neurotoxicity in rats by a standardized extract of *Cydonia oblonga* seeds. *Bangladesh Journal of Medical Science*, 21(4): 848–857.
- [17] Latif A, et al. (2020). Phytochemical analysis and in vitro investigation of anti-inflammatory and xanthine oxidase inhibition potential of root extracts of *Bryophyllum pinnatum*. *Journal of Animal & Plant Sciences*, 30(1).
- [18] Haider S, Ali SM (2023). Antimicrobial activity, alone and in conjunction with cefuroxime. *International Journal of Pharmacy & Integrated Health Sciences*, 4(1).
- [19] Munir MU, et al. (2022). Analgesic and anti-diabetic potential of *Roystonea regia*. *International Journal of Pharmacy & Integrated Health Sciences*, 3(2): 3–14.
- [20] Tessema TD, Wendante YS, Teffera B (2024). Experimental dataset on leaf-based extracted antidandruff shampoo derived from Aloe Vera, Ocimum sanctum, and Withania somnifera: Advancing Ethiopian local herbs via formulation. *Data in Brief*.
- [21] Piérard-Franchimont C, Uhoda E, Loussouarn G, Saint-Léger D, Piérard GE (2003). Effect of residence time on the efficacy of antidandruff shampoos. *International Journal of Cosmetic Science*.
- [22] Rincón-Fontán M, Rodríguez-López L, Vecino X, Cruz IM, Moldes AB (2020). Novel multifunctional biosurfactant obtained from corn as a stabilizing agent for antidandruff formulations based on Zn pyrithione powder. *ACS Omega*, 5(11): 5704–5712.
- [23] Piérard GE, Arrese JE, Piérard-Franchimont C, De Doncker P (1997). Prolonged effects of antidandruff shampoos time to recurrence of *Malassezia ovalis* colonization of skin. *International Journal of Cosmetic Science*, 19(3): 111–117.
- [24] Falcão B, Marques M, Nunes B (2019). Behavioral and biochemical effects of zinc pyrithione on freshwater fish *Gambusia holbrooki*. *Fish Physiology and Biochemistry*, 45(4): 1495–1512.
- [25] Angiolella L, Carradori S, Maccallini C, Giusiano G, Supuran CT (2017). Targeting *Malassezia* species for novel synthetic and natural antidandruff agents. *Current Medicinal Chemistry*, 24(22): 2392–2412.
- [26] Bhinge SD, et al. (2021). Screening of hair growth promoting activity of *Punica granatum* leaves extracts and its antidandruff and anti-lice effect. *Heliyon*, 7(4): e06903.



-
- [27] Rincón-Fontán M, et al. (2020). Novel multifunctional biosurfactant obtained from corn as a stabilizing agent for antidandruff formulations based on Zn pyrithione powder. *ACS Omega*, 5(11): 5704–5712.
- [28] Piérard-Franchimont C, et al. (2003). Effect of residence time on efficacy of antidandruff shampoos. *International Journal of Cosmetic Science*, 25(6): 267–271.
- [29] Piérard-Franchimont C, et al. (2002). Nudging hair shedding by antidandruff shampoos. *International Journal of Cosmetic Science*, 24(5): 249–256.
- [30] Orentreich N, et al. (1969). Comparative study of two antidandruff preparations. *Journal of Pharmaceutical Sciences*, 58(10): 1279–1280.
- [31] Jourdain R, et al. (2023). *Malassezia restricta*-mediated lipoperoxidation: A novel trigger in dandruff. *Acta Dermato-Venereologica*, 103: adv00868.
- [32] Saunders CW, Scheynius A, Heitman J (2012). *Malassezia* fungi are specialized to live on skin and associated with dandruff, eczema, and other skin diseases. *PLoS Pathogens*, 8(6): e1002702.
- [33] Gagliardi L, et al. (2008). HPLC determination of imidazole antifungals in antidandruff cosmetic products. *Analytical Science*.
- [34] Walli RR, et al. (2015). Screening of antimicrobial activity of fenugreek seeds. *Pharmacology & Pharmacology International Journal*, 2(4): 1–4.
- [35] Dharajiya DA, et al. (2016). Evaluation of antibacterial and antifungal activity of fenugreek (*Trigonella foenum-graecum*) extracts. *International Journal of Pharmacy and Pharmaceutical Sciences*, 8(4): 212–217.
- [36] Sulieman AME, Ahmed HE, Abdelrahim AM (2008). The chemical composition of fenugreek (*Trigonella foenum-graecum* L.) and antimicrobial properties of its seed oil. *Gezira Journal of Engineering and Applied Sciences*, 3: 52–71.