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Formulation and Evaluation of Herbal Anti-Dandruff Shampoo Containing Banana Blossom Extract (Musa sapientum)

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Abstract
Banana have a massive scope of nutritional value, health effects and potential benefits which are important in maintaining good health. The concoction of its flower or blossom has potential as an essential wild food and medicinal plant which contains numerous beneficial effects to the body's health and is effective in treating and preventing several types of diseases. The study aspires to find a natural anti-dandruff agent or cosmetic product made from plant-based herbs alternative to synthetic shampoo. This was conducted in order to produce an effect by using the ethanolic crude extract of banana blossom. The study employed Phytochemical screening to identify bio-active compounds with potential medicinal and nutritional property present in the plant sample. However, High Performance Liquid Chromatography was utilized to analyze the phytochemical composition of the plant extract to determine the secondary metabolite present such as quercetin as flavonoid and Gallic acid as phenolic acid. Additionally, Disc diffusion method was conducted to determine the anti-fungal activity of the ethanolic crude extract of banana blossom against two fungal pathogens. Moreover, the formulated anti-dandruff shampoo was compared to commercially available anti-dandruff shampoo and evaluated in terms of physical or visual appearance, pH value, dirt dispersion, wetting time, foam formation and solid contents. The study highlights the potential of banana blossom extract as a key ingredient in herbal shampoos, offering a safer alternative to synthetic formulations.

Keywords: Anti-Dandruff, Banana Blossom Extract, Herbal Shampoo

1. Introduction

Dandruff is one of the most common dermatological conditions, characterized by excessive flaking of the scalp. The human scalp provides a suitable environment for microbial growth including *Staphylococcus* spp, *Propionibacterium* spp, and *Malassezzia* spp. Although dandruff is not a serious medical condition, it can significantly impact self-esteem and social interactions. Traditionally, dandruff management involves the use of synthetic and herbal-based anti-dandruff shampoos. Banana blossoms (*Musa sapientum*) are always thrown away as agricultural waste, but they have a lot of Phytochemical constituents, antioxidant qualities, and medicinal benefits, which makes them a potential functional food with many nutritional benefits that are vital in maintaining good health (Suffi et al., 2021).It comprises proteins, dietary fiber, vitamins, flavonoids (especially quercetin), tannin, and B-tocopherol (Lau et al., 2020). Banana blossoms (or banana flowers) are high in bio-active compounds and secondary

metabolites that contribute to their potential health benefits and always conclude as agriculture waste in which by-product are also rich in bio-active compounds and are extremely required for our health maintenance. Majority of dandruff cases can be resolved with certain shampoos. Growing concerns regarding the safety of chemical-based personal care products have led to an increased interest in natural and herbal remedies. This study explores the potential anti-fungal effectiveness of banana blossom extract as natural alternative to synthetic formulations. By assessing the potential anti-dandruff effect of banana blossom extract through phytochemical screening, instrumentation techniques and microbial assay, the researcher search to scientifically authenticate and contribute the use of banana blossom in scalp disorders.

2. Methodology

2.1 Research Design

This study employed the experimental method of research to formulate and evaluate the herbal anti-dandruff shampoo containing banana blossom extract. Through the methodical manipulation of the independent variable which is banana blossom extract and observing its potential effects on the dependent variable anti-dandruff shampoo. The goal of the study was to clearly show and establish cause-and-effect relationships. It allows researchers to draw reasonable conclusions about whether a particular treatment leads to a specific result by comparing outcomes under different experimental conditions. Formulation of five anti-dandruff shampoo were assigned to an experimental and evaluation on different parameters and was assessed through various tests. The involvement of the instrumentation techniques and microbial assays further enhanced the validity of the effectiveness in the state of the scalp by using the anti-dandruff shampoo and confirming its dependability and scientific validity of the research.

2.2 Research Locale and Sampling Technique

The experimental procedures for this study were primarily conducted at Department of Science and Technology-Taguig for phytochemical screening, following standard procedures to identify the plant constituents present in *Musa sapientum* and Disc diffusion assay, for the identification of inhibitory activity of the plant extract against the two fungal pathogens. However, the plant extract of banana blossom (*Musa sapientum*) was submitted to UPH-Dr. Jose G. Tamayo Medical University for analysis of its bio-active compounds using High-Performance Liquid Chromatography (HPLC). The sampling technique employed was random sampling within the experimental framework, where the banana blossom extract were randomly assigned to test for the identification of secondary metabolites present in the plant extract and identify the inhibitory activity and reactivity against the sample fungal pathogens.

2.3 Materials and Instruments

All plant materials like Neem oil, Lemon grass oil, Eucalyptus oil, Glycerin were procured from an online shop (Asteria Apothecary). Sodium lauryl sulfate, ethylenediaminetetraacetic acid (EDTA), sodium hydroxide and sodium chloride which was also procured from the local market. Collected plant part was collected from Calumpang West, San Luis, Batangas. The fresh banana blossom was washed and cleaned thoroughly with tap water followed by sterilized distilled water and cut into small pieces; sun dried for a few days, and the dried banana blossom was pulverized and stored in air tight container then macerated for 72 hours. The filtrate was evaporated using a rotary evaporator at MCS | RTF-Laboratory at not more than 50º C to obtained the crude extracts. The purpose of use in the herbal

shampoo and each ingredient was carefully incorporated step-by-step, ensuring uniform mixing to achieve a consistent shampoo formulation are mentioned below.

Table 1. Composition of Formulated Herbal Anti-dandruff Shampoo and Uses

Ingredients	Uses
Neem oil	Anti-fungal and antibacterial effects, scalp soothing, moisturizing effect, hair strengthening
Lemongrass oil	Anti-fungal and antibacterial effects, scalp soothing, refreshing scent, hair strengthening
Eucalyptus oil	Anti-fungal and antibacterial effects, scalp soothing, refreshing sensation, hair strengthening
Sodium Lauryl Sulfate	Cleansing action, foaming properties, emulsifier and dandruff removal
Glycerin	Hydration and Moisture retention, soothing effect, improve hair texture, enhances herbal extract absorption
Ethylenediaminetetraacetic acid	Enhance stability, improves foaming and cleansing, boosts antimicrobial activity and chelating agent
Sodium Chloride	Viscosity enhancer, cleansing agent, foam stabilizer, exfoliating effect and improves ingredient solubility
Sodium Hydroxide	pH regulator, enhance ingredients stability, improves cleansing efficiency and prevents excessive acidity
Water	Solvent, enhance herbal extract efficacy, improves spread-ability, hydration and moisturizer
Perfume	Pleasant scent, mask herbal odors and boost freshness

Preparation of Shampoo

Accurately 50 grams of semi-liquid crude extract were taken, extracted with 80% ethanol at below 50ºC. Aqueous extract of all the crude extract were measured and mixed in required quantities as shown in table 2. The created shampoo was kept in a tight container and utilized for additional assessments.

Table 2. Composition of Formulated Herbal Anti-dandruff Shampoo

	Ingredients	Quantity
1	Neem oil (ml)	2ml
2	Lemongrass oil (ml)	2ml
3	Eucalyptus oil (ml)	2ml
4	Banana blossom extract (gms)	2g
5	Sodium Lauryl Sulfate (gms)	20g
6	Glycerin (ml)	1ml
7	Ethylenediaminetetraacetic acid (EDTA)	0.15g

8	Sodium Chloride (gms)	2g
9	Sodium Hydroxide	To adjust pH
10	Water	q.s
11	Perfume	q.s
	Total	100mL

Evaluation of prepared shampoo

To evaluate the quality of commercial and prepared formulation, several quality tests were performed. Prepared herbal shampoo formulation should be evaluated for its physical appearance, pH, dirt dispersion, foaming ability, wetting time, percentage of solid content, viscosity and anti-fungal activity against *Aspergillus brasiliensis* and *Candida albicans*.

Physical appearance/visual inspection: The formulated shampoo will be done on a portion of the extract and the formulation prepared was evaluated to determine appearance, color, odor and foam producing ability.

Determination of pH: The pH of 10% shampoo solution constituted in distilled water and the pH of the solution was measured by using a calibrated pH meter. The acidity and alkalinity of the crude extract was also determined using a pH meter. Neutral pH = 7 Acidic pH < 7 Basic pH > 7.

Dirt dispersion: Two drops of shampoo were introduced to a large test tube containing 10 milliliters of distilled water. 1 drop of India ink was added; the test tube was stopped and shaken ten times. There were four estimated levels of ink in the foam: None, Light, Moderate, or Heavy.

Foam formation (Shake test): To assess the foaming ability, the cylinder shaking method was employed. On a portion (50ml) of the 10% shampoo solution, (5 ml of shampoo and 45 ml of distilled water) in a 250ml graduated cylinder. Shake for 10 times while covered with one hand. After 1 min of shaking, the total volume of the foam content was recorded and measured after 1 minute and foam stability was determined by recording the foam volume from 1 min to 4 min of shake test.

Wetting time: A cotton ball weighing about 0.44gm was taken and added to a container containing shampoo. Wetting time was defined as the amount of time it took for cotton to sink to the bottom of the formulation.

Determination of solid content: The percentage of solid content was determined by weighing about 4 grams of shampoo in an evaporating dish. The liquid portion of shampoo was evaporated by placing it on a hot plate. Finally, the weight and percentage of solid present in shampoo (solid) was calculated for complete drying.

Measurement of viscosity: The viscosity of the shampoos will be measured by internal friction of a fluid when a layer of the fluid is forced to move in relation to another layer. Viscosity is a measurement that is heavily influenced by temperature during the study.

Measurement of refractive index: The refractive index of the shampoo is for determining the entire amount of dissolved solids in shampoo, including surfactant and other active anti-dandruff chemicals in the sample. Utilizing an Atago handheld refractometer and the Atago Handles Pocket Refractometer Instruction manual, Optimal Laboratories performed Refractometry.

In vitro anti-dandruff activity: *Aspergillus brasiliensis* and *Candida albicans* were employed for testing anti-fungal activity using a point inoculates fungi to a Potato Dextrose Agar (PDA) slant and incubated for 5-7 days. After a profuse fungal growth has formed, the fungi suspended in 10-20ml of sterile distilled water using a wireloop, then added 200µL of the fungal suspension to a standard-size sterile petri-dish. Approximately 15-20ml of Potato Dextrose Agar was added then swirl, and allow plates to congeal and dry. The plates incubated at 25ºC for an hour adding the filter paper discs containing the samples for testing. Three replicates and trials were done using 100% concentrations on the testing. After the completion of incubation period, the zone of inhibition in millimeter was measured.

3. Results and Discussion

Table 3. Chemical Composition or Bio-active Constituents of Banana Blossom (*Musa sapientum*)

Plant Constituents	Result	Test Method
Sterols	+	Liebermann-Burchard Test
Triterpenes	+	
Flavonoids	+	Shinoda Test
Alkaloids	+	Mayer's Test
Saponins	+	Froth's Test
Glycosides	+	Fehling's Test
Tannins	+	Ferric Chloride Test

The phytochemical screening of Banana blossom *Musa sapientum* extract identified presence of sterol, triterpenes, flavonoids, alkaloids, saponins, glycosides and tannins. These bioactive compounds are known for their antimicrobial, anti-inflammatory, antioxidant, and cleansing properties. Their presence supports the potential of the extract as an effective natural ingredient in anti-dandruff formulations, promoting scalp health and inhibiting dandruff-causing pathogens.

Table 4. Instrumental Techniques Using High Performance Liquid Chromatography

Sample	Retention Time	Banana blossom extract
Standard Quercetin	1.678	1.591
Standard Gallic acid	1.482	3.60

The chromatographic analysis using High Performance Liquid Chromatography of the banana blossom extract revealed a prominent peak at 1.59 minutes, matching the retention time of standard quercetin, confirming its presence in high concentration. A smaller peak at 3.60 minutes corresponds to gallic acid, indicating a lower concentration of this tannin. The smooth baseline and well-separated peaks indicate good resolution and effective compound separation. These finding confirm the presence of key bio-active compounds, particularly flavonoids and tannins, supporting the extract's potential for pharmacological or cosmetic applications.

Table 5. Secondary Metabolites Present in the Crude Extract of Banana Blossom

Secondary Metabolite	Example	Known for
Flavonoids	Quercetin, Kaempferol	Antioxidant, anti-inflammatory, and anti-fungal effects
Tannins	Gallic acid, Ellagic acid	Astringent, antimicrobial, and anti-fungal activities
Saponins	___	Surface-active properties, anti-fungal and antibacterial action
Sterols and Phytosterols	___	Anti-inflammatory and anti-fungal properties

The banana blossom extract contains flavonoids, tannins, saponins, and phytosterols, which are known for their strong antioxidant, anti-inflammatory, and anti-fungal properties. This supports the extract's potential effectiveness in scalp treatment and as a key ingredient in anti-dandruff formulations.

Table 6. Anti-Dandruff Effect of the Crude Extract of Banana Blossom (*Musa sapientum*)

Sample	*Aspergillus brasiliensis* (ATCC 16404)			*Candida albicans* (ATCC 10231)		
	Total Mean Zone of Inhibition	Reactivity	Inhibitory activity	Total Mean Zone of Inhibition	Reactivity	Inhibitory activity
Banana blossom Extract(10mm)	10.00	2	++	10.00	2	++
Positive Control: Clotrimazole(10mm)	18.71	3	+++	17.67	3	+++
Negative Control: Sample-free disc (10mm)	0.00	-	-	0.00	-	-

The herbal anti-dandruff shampoo containing banana blossom *Musa sapientum* extract demonstrated moderate anti-fungal activity, with a 10.00mm mean zone of inhibition and a reactivity score of 2 (++ rating) against both *Aspergillus brasiliensis* and *Candida albicans*. In contrast, the positive control, Clotrimazole, showed significantly stronger activity with inhibition zones of 18.71mm and 17.67 mm, a reactivity score of 3, and a +++ rating. The negative control showed no inhibition (0.00 mm), confirming the reliability of the test. These results highlight the extract's anti-fungal potential, likely due to its bioactive compounds supporting its use in natural anti-dandruff shampoo formulations.

Formulated Herbal Anti-dandruff Shampoo

Herbal shampoo was formulated by simple mixing extract of Banana blossom (*Musa sapientum*) with

composition of formulated herbal shampoo in definite amount. These plants contain a variety of phytochemicals like tannin and flavonoids which have anti-fungal activity; *Azadirachta indica*, *Cymbopogon citratus,* and *Eucalyptus globulus*, was added for its anti-fungal properties for combating and disrupts fungal growth and reproduction. Sodium lauryl sulfate was included in shampoo to aid in removing fungal biofilms and debris from the scalp or skin and trapping oil and dirt in hair, so it can rinse away with water. A good shampoo should not flow off the hair while being used but should have enough viscosity to make removal from the container easy. Sodium Hydroxide was added to adjust the pH to maintain the acidic pH of formulation. Glycerin was added to the formulated herbal shampoo because it acts as humectant that helps the hair and scalp retained its moisture.

Table 7. Comparison of Formulation and Evaluation of Anti-Dandruff Shampoo Containing Ethanolic Extract of *Musa sapientum* vs Commercially Available Anti-Dandruff Shampoos

Formulation	Physical appearance / visual inspection	pH value	Dirt dispersion	Wetting time	Foam formation	% solid contents
1	Light Brown, Minty citrus odor	6.53	Light	180 ± 0.77	125	24.13
2	Light Brown, Minty citrus odor	6.22	Light	182 ± 0.24	175	23.53
3	Medium Brown, Minty citrus odor	6.30	Light	174 ± 0.34	150	26.17
4	Dark Brown, Minty citrus odor	6.34	Light	186 ± 0.55	155	28.19
5	Dark Brown, Minty citrus odor	6.38	Light	179 ± 0.12	150	27.14

The results of the comparison between the formulation of anti-dandruff shampoos containing ethanolic extract of *Musa sapientum* and commercially available anti-dandruff shampoos show the following findings:

Physical Appearance / Visual Inspection: The formulations vary in color from light brown to dark brown, with a minty citrus odor present across all samples. This suggests consistency in fragrance, but slight variation in color, possibly due to different concentrations or processing methods of the banana blossom extract.

pH Value: The pH values of the formulations range from 6.22 to 6.53, which are close to the ideal pH range for scalp health (4.5–5.5). These values suggest that the formulations are well-suited for use on the scalp without causing irritation or disrupting the scalp's natural acidity.

Dirt Dispersion: All formulations exhibit light dirt dispersion, indicating that the shampoos are effective in dispersing dirt and oils from the scalp, which is an important feature in cleansing and preve-

nting dandruff.

Wetting Time: The wetting time for all the formulations is ranges from 174 to 186 seconds. These times are relatively consistent, with slight variations, suggesting that the shampoos have similar spreading properties on the scalp and hair, making them easy to apply.

Foam Formation: The foam formation varies from 125 to 175 ml, with formulations showing moderate foam production. This indicates that while the shampoos may not produce as much foam as some commercial products, they still generate a reasonable amount of lather, which is desirable for consumer satisfaction.

% Solid Contents: The percentage of solid content ranges from 23.53% to 28.19%, which reflects the concentration of active ingredients in the shampoo. Formulation 4 has the highest solid content at 28.19%, suggesting it may be more concentrated or contain a higher proportion of bio-active compounds, potentially enhancing its anti-fungal and therapeutic properties.

In summary, the formulations of the banana blossom-based anti-dandruff shampoos show promising characteristics, with moderate foam formation, good dirt dispersion, and a suitable pH for scalp health. The variations in solid content and wetting time may provide opportunities for further optimization in future formulations.

Table 8. Result of Evaluation Parameter of Shampoo

Commercially available shampoo	Physical appear-ance / visual in-spection	pH value	Dirt dispersion	Wetting time	Foam formation (mins)	% solid contents
Brand A	Light Pink	5.47	None	141	197.6	30%
Brand B	Dark Green	5.39	Light	195	176.4	23.75%
Brand C	Cream	5.10	Light	250	159	27.50%
Brand D	Light Mint green	6.39	Moderate	230	268.6	22.50%

The results for the commercially available anti-dandruff shampoos show the following findings:

Physical Appearance / Visual Inspection: The shampoos vary in color, with Brand A being light pink, Brand B dark green, Brand C cream, and Brand D light mint green. The visual differences are likely due to the use of different dyes, fragrances, or ingredients in each formulation.

pH Value: The pH values range from 5.10 (Brand C) to 6.39 (Brand D). These pH levels are generally suitable for scalp use, as they fall within or near the optimal range (4.5–5.5), which helps maintain the scalp's natural acidity. Brand C's pH is slightly lower, while Brand D is at the higher end, which may be more suitable for specific scalp conditions.

Dirt Dispersion: Brands A, B, and C has light dirt dispersion, indicating that they are capable of lightly dispersing oils and dirt from the scalp. However, Brand D shows moderate dirt dispersion, suggesting that it may have a stronger cleansing action or contains higher concentrations of surfactant.

Wetting Time: The wetting time ranges from 141 minutes (Brand A) and 250 minutes (Brand C). A longer wetting time generally suggests that the shampoo takes longer to spread and apply to the scalp. Brand C's higher wetting time might indicate slightly slower application, while Brand A's shorter wetting time could suggest it's quicker to apply.

Foam Formation: Foam formation varies from 159 ml (Brand C) to 268.6 ml (Brand D). Brand D produces the highest foam, which is often preferred by consumers for its association with a more

effective cleaning experience. Brand A also produces a significant amount of foam, while Brand B and Brand C produce relatively lower foam.

% Solid Contents: The solid content ranges from 22.50% (Brand D) to 30% (Brand A). Higher solid content often correlates with more active ingredients in the shampoo, potentially making it more effective. Brand A, with the highest solid content (30%), may be more concentrated than the others.

Table 9. Shampoo Viscosity Analysis Using 600ml of Formulated Shampoo

Parameter	Method	Result
Viscosity, m Pas	Viscometer	1,460cps

According to the *Myr Viscometer Manual*, the viscosity of anti-dandruff shampoos typically ranges from 1,010 to 1,700 centipoise (cPs), depending on their specific formulation. Viscosity plays a crucial role in product performance, influencing both the ease of application and rinsability. In this study, the viscosity of the sample shampoo was measured at 1,460 cps, indicating an optimal consistency that allows the product to be evenly distributed on the scalp while remaining easy to rinse off. This result confirms the formulation's suitability for practical consumer use, balancing thickness and usability.

Table 10. Shampoo Refractive Index of Formulated Shampoo

Sample : 600ml Formulated Shampoo with Banana blossom extract		
Parameter	**Method**	**Result**
Brix	Refractometry	12.6 %

According to the Atago Handheld Pocket Refractometer Instruction Manual, refractometry is a reliable method for determining the concentration of total dissolved solids in liquid formulations. In this study, the Brix value of the formulated shampoo containing banana blossom extract was measured using an Atago handheld refractometer. The Brix scale, which ranges from 0.0% to 93.0%, is appropriate for assessing the presence of soluble components such as surfactant and active anti-dandruff agents. As presented in Table 16, the measured Brix percentage provides an indication of the shampoo's formulation strength and concentration of functional ingredients, supporting its potential efficacy as an anti-dandruff product.

4. Conclusion and Recommendations

Conclusion

Based on the findings of the study, the extract's efficacy in dandruff control is attributed to the synergistic action of its bio-active constituents, particularly flavonoid, tannin, and other secondary metabolites. These compounds work in combination to enhance the overall anti-fungal and anti-inflammatory properties of the formulation, thereby improving its therapeutic potential. The findings of this study suggest that banana blossom extract exhibits significant potential as a natural alternative to conventional synthetic anti-dandruff treatments. The formulated shampoo presents a promising, cost-effective, and sustainable approach to dandruff management. Its positive effects on scalp health can be attributed to the presence of bio-active compounds in the banana blossom extract, while contribute to its therapeutic potential through anti-oxidant, anti-inflammatory, and anti-fungal mechanisms.

Recommendations

For future research and development, further studies are recommended to focus on the isolation and characterization of individual bio-active compounds present in the extract, in order to elucidate their specific anti-fungal mechanisms and contribute to a deeper understanding of their therapeutic potential. It is recommended to expand pathogen testing of the extract to include a broader spectrum of dandruff-associated fungal species, particularly those within the *Malassezzia* species, in order to further validate and strengthen its anti-fungal profile. Further optimization of the shampoo formulation is recommended to enhance its texture, stability, fragrance, and shelf life. These improvements are essential for increasing consumer acceptability and ensuring overall product quality and marketability. Conducting clinical trials involving human subjects is recommended to validate the safety, efficacy, and consumer acceptability of the banana-based shampoo. Such evaluations are essential to substantiate laboratory findings and support its potential form commercial application. Further investigation into the application of banana blossom extract in other dermatological or cosmetic formulations is recommended to explore its broader commercial potential and therapeutic benefits across various skincare and personal care products. The development and promotion of herbal anti-dandruff products should be encouraged as they offer safe, cost-effective, and environmentally sustainable alternatives to conventional synthetic formulations, aligning with the growing demand for natural and eco-conscious personal care solutions.

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