Formulation and Evaluation of Naturally Derived Shampoo Bar

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Abstract: A shampoo bar is a solid form of a conventional hair cleaner. Shampoo bars are a popular alternative to traditional liquid shampoo providing a convenient, eco-friendly, and travel-friendly option for consumers. Shampoo bars do not only eliminate plastic containers. Even though natural shampoo bars are safer and perform better than synthetic ones. Naturally derived shampoo bars are composed of natural ingredients that are free from harsh sulfates like those in synthetic shampoos. In order to minimize the use of plastic the present study aimed to formulate shampoo bars made from natural ingredients and evaluate their physicochemical properties. Ingredients from different kinds of natural sources were incorporated to formulate the naturally derived shampoo bar. To evaluate the physicochemical characteristics of the formulated naturally derived shampoo bar various types of tests were performed including visual inspection, pH, foam ability, and stability. The dirt dispersion test and surface tension measurement were evaluated. Results indicate that the shampoo bar made from natural ingredients used in this formulation are safer, further research is necessary to increase its quality and safety with better cleansing and conditioning properties.

Keywords: Natural Shampoo Bar; Sulfate-Free Shampoo Bar; Solid Shampoo; Paraben Free.

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I. INTRODUCTION

One of the hair care products that cleans the hair and scalp is a shampoo bar. There are a lot of shampoos available on the market from various sources. However, this study aimed to determine whether SLS-free products can be used in place of shampoo bars because these shampoos contain hazardous chemicals. Because of the negative effects of synthetic ingredients on the environment and human health, consumers are becoming more aware of these issues and are seeking alternative products that are both environmentally friendly and safe to use.



Fig 1: Shampoo Bar

➤ Hair:

Hair is a complex structure made up of different components that function to protect the scalp biologically and improve the individual's perception of beauty and physical appeal. Each hair strand is made up of dead keratin cells. Hair plays an important role in physical appearance, thermoregulation, body regulation, social communication, and protection from environmental factors such as ultraviolet radiation from the sun and mechanical damage from wind and temperature changes.

Structure of Hair Fiber:

Hair is composed of a strong protein called keratin and has a basic structure consisting of a root and a shaft. The strength of hair is determined by this keratin. The hair fiber, which ranges in diameter from 50 to 100 μ m, serves both protective and cosmetic functions. The cuticle, cortex, and medulla are the three basic morphological components of human hair fibers, which are also made up of the hair follicle.

> The chemical composition of hair:

Up to 32% water by weight and 65–95% protein by weight are found in hair fiber. Lipid pigments are additional components. Additionally, the amino acids glycine, threonine, glutamic acid, aspartic acid, lysine, cysteine, and tyrosine are essential for healthy hair. Therefore, α -keratin is the chemical component that determines the characteristics of human hair.

II. FORMULATION CONSIDERATION

Surfactant:

A blend of surfactants that cleans the dirt and debris deposited on the scalp while providing appropriate detergency and foaming qualities. Fatty alcohol sulfates are the most often utilized, even though mild surfactants should be employed in the naturally derived shampoo bar. As a result, an anionic surfactant is frequently used as the formulation's basis to provide foam and detergency. An amphoteric and non-ionic combination is usually added to anionic surfactants to boost their mildness and lessen the possibility of irritation.

Bar Hardeners:

Bar hardeners are ingredients that are commonly used in solid shampoo bars to improve their durability and increase their hardness. These ingredients help the shampoo bars maintain their shape and prevent them from becoming too soft when wet. To harden the bar, use fatty alcohols and fatty acids. In addition, vegetable-origin waxes are complex that contain alcohols, fatty acids, and esters and are highly resistant to oxidation, moisture, and microbial degradation, they can also be used as hardeners. Also, they provide stability and increase the mixture's viscosity and consistency.

Conditioning Agents:

Specifically for dry and damaged hair, conditioning agents are employed to provide softness, gloss, and detangling

benefits. Shampoo bars primarily use oils and butter as conditioning agents, but they can also include cationic surfactants, fatty alcohols, silicones, and natural oils, each offering unique benefits. For neutralizing the oil-stripping effects of the surfactant, these substances help prevent hair from drying out. To retain the hardness of the shampoo bar and provide hair nutrition, it's necessary to add them in the correct amounts.

> Buffers:

pH plays an important role in determining its health and appearance. Hair's natural pH ranges from 4.5 to 5.5, which is slightly acidic. Shampoos with higher pH levels can cause hair damage by disrupting the hair's cuticle, leading to frizz, split ends, and breakage. Shampoos with a lower pH may irritate and dry up the scalp. The pH of a shampoo bar can also affect its cleansing ability.

> Preservatives:

These are required to preserve the shampoos against bacteria or mold contamination by adding preservatives. Depending on the formulation's water content and formulation conditions, preservatives may or may not need to be added to shampoo bars. Preservatives may need to be used to avoid microbial contamination.

> Perfumes:

Essential oils provide the shampoo with its desired fragrance. Aromatic plants and their natural oils are used for a variety of purposes. Essential oils produce a pleasant aroma, shine, and conditioning effect in addition to a long-lasting sense of refreshment.

III. MATERIALS

> Fenugreek:

Fenugreek belongs to the Fabaceae family. Fenugreek seeds are rich in protein, nicotinic acid linolenic acid, oleic acid, calcium, phosphorus, iron, niacin, fixed oil, and vitamin C. **Uses:** Fenugreek powder helps to grow hair faster, reduces hair fall, conditions hair, and repairs damaged hair.

➢ Rice Water:

Rice is a grain that belongs to the Poaceae family. Rice water is a starch suspension made by either draining boiled rice or boiling it until all of the starch has dissolved into the water. **Uses:** Rice water can strengthen hair follicles, increase hair luster and look, repair cuticle damage, stop dandruff, and prevent illnesses.

Sodium Cocoyl Isethionate:

Sodium cocoyl isethionate is a natural ingredient that is made from coconuts. The process includes mixing a natural sulfonic acid called isethionic acid with the fatty acids that naturally occur in coconut oil. **Uses:** Surfactant, gentle cleansing agent. Volume 10, Issue 4, April – 2025

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Cocamidopropyl Betaine:

Dimethylaminopropylamine and coconut oil are the sources of the mixture of closely related chemical compounds known as cocamidopropyl betaine, which usually acts as an amphoteric surfactant. **Uses:** Amphoteric surfactant, foam booster, thickener.

Cocoa Butter:

The fatty seeds of the cacao tree (Theobroma cacao), which belongs to the Malvaceae family, are used to make cocoa butter. It is made up of stearic, oleic, and palmitic acids.

➤ Uses:

Repairs dry and damaged hair.

Coconut Oil:

The coconut tree (Cocos nucifera) belongs to the Arecaceae family and contains coconut oil, which is made up of fatty acids, stearic acid, oleic acid, linoleic acid, lauric acid, myristic acid, palmitic acid, and caprylic and capric acids. **Uses:** Helps to moisturize and repair damaged hair.

Citric Acid:

Aspergillus Niger or Candida sp. are used in submerged fermentation to produce it from various sources of carbohydrates, including molasses and starch-based media. **Uses:** Citric acid lowers pH levels in shampoo formulas, improving the look and manageability of hair by minimizing frizz.

Cetyl Alcohol:

Whale oil is no longer the main source of cetyl alcohol; instead, it is either a byproduct of the petroleum industry or derived from vegetable oils like coconut and palm oil. Uses: Moisturizer, opacifier, emulsifier, thickening agent, and increase and stabilize the foaming capacity.

Stearic Acid:

Stearic acid is the main component in cocoa butter and shea butter and can be found in a variety of animal and plant fats. **Uses:** Used in the production of detergents and bars of soaps.

➤ Rosemary Oil:

The flowering tops of the leafy twigs of the Lamiaceae plant Rosmarinus officinalis are used to extract the oil of rosemary. P-cymene, linalool, beta-pinene, alpha-pinene, gamma-terpinene, thymol, and eucalyptol are its constituents. **Uses:** Increases the growth of hair.

IV. EQUIPMENT AND APPARATUS

- Weighing balance
- pH paper
- Heating mantle
- Mechanical stirrer

- Thermometer
- White muslin cloth
- Water bath
- Glass stirrer
- Tripod stand
- Beaker
- Porcelain dish
- Measuring cylinder
- Test tube
- Test tube stand

V. FORMULATION

S.NO	INGREDIENTS	F1	F2
1.	Fenugreek	10gm	8gm
2.	Rice water	5%	5%
3.	Sodium cocoyl isethionate	38%	45%
4.	Cocamidopropyl betaine	20%	20%
5.	Cocoa butter	8%	5%
6.	Coconut oil	7%	2%
7.	Citric acid	0.5%	1%
8.	Cetyl alcohol	5%	6%
9.	Stearic acid	10%	10%
10.	Rosemary oil	1%	0.5%

VI. PROCEDURE

- Soak a certain amount of fenugreek seeds in water for 8-10 hours.
- Take the soaked fenugreek seeds and grind them to get a thick paste.
- Take a sufficient amount of rice and soak it in water for 2-3 hours.
- Once the rice is completely submerged in water, boil it. Extract the rice water using a white plane muslin cloth.
- Using a water bath, by double boiler method, sodium cocoyl isethionate was melted to 80°C.
- Cocoamidopropyl betaine and citric acid were melted separately at 80°C in a water bath.
- Both mixtures are blended at 80°C. Stir gently until fully melted.
- In a separate vessel melt together the oil-soluble ingredients such as cocoa butter, coconut oil, stearic acid, and cetyl alcohol until fully melted at 90C.
- Once mixtures are fully melted, combine with the above mixture and blend with a mechanical stirrer until fully incorporated.
- Add the fenugreek paste, and rice water to the above mixture and blend until evenly distributed.
- Finally, Rosemary oil was added to the above mixture and evenly distributed.
- Checked the temperature of the mixture using a thermometer. Once it has cooled down to around 45°-55°C, pour the mixture into your silicone soap mold.

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- Allowed shampoo bar to cool down and harden for at least 24hours.
- Once fully hardened, remove the shampoo bar from the mold.

VII. EVALUATION

A. Visual Inspection:

The formulated shampoo bar colour, texture, and clarity were identified by the naked eye on a white background. An odour of the shampoo bar was smelled for its fragrance.

> *Determination of pH*:

A calibrated pH meter was used to measure the pH of a 10% w/v shampoo bar solution made from distilled water (pH strips can also be used). The pH of a shampoo bar made with surfactants will likely be in the range of 4.5 to 6.5.

Dirt Dispersion:

Two drops of shampoo bar solution were added to a test tube that contained 10 ml of distilled water. One drop of Indian ink was added, and the test tube was then covered and shaken ten times. There are four levels of ink in the bubble: none, mild, moderate, and heavy.

B. Surface Tension Measurement:

> Drop Count Method:

Measurements were carried out using a 10% w/v shampoo bar at room temperature in a thoroughly cleaned stalagmometer using purified water. Drops are counted as the liquid moves from point A to point B. The average value is obtained by repeating the procedure three times.

Foaming Ability & Foaming Stability:

The most used technique for foaming ability is the cylinder shake method. A 250 mL graduated cylinder was filled with 50 mL of the 1% w/v shampoo bar solutions. The cylinder was then covered with a hand and shaken ten times. After a minute of shaking, the total amount of the foam contents was noted. As soon as the foam was shaken, the volume of foam was measured and recorded every one minute for four minutes.

VIII. RESULTS AND DISCUSSION

Naturally derived shampoo bar (solid shampoo) was formulated and evaluated.

Physicochemical parameters:

Table 2: Physicochemical parameters of naturally derived shampoo ba

S. No	Parameter	F1	F2
1.	Colour	Subtle yellowish brown	Subtle yellowish brown
2.	Odour	Pleasant	Pleasant
3.	Texture	Formless	Good consistent, rigid
4.	Cracks	Some cracks	Doesn't have cracks



Fig 2: Formulated Naturally Derived Shampoo Bar

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▶ pH Test:

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Table 3: pH of Naturally Derived Shampoo Bar					
S. No	S. No Parameter F1 F2				
1.	рН	5	5.5		



Fig3: pH

> Dirt Dispersion Test:

Table 4: Dirt Dispersion Test of Naturally Derived Shampoo Bar

S. No	Parameter	FÍ	F2
1.	Dirt dispersion	Moderate	Light



Fig 4: Dirt Dispersion

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> Surface Tension Measurement:

Table 5: Surface Tension Measurement of Naturally Derived Shampoo Bar					
S. No	Parameter	F1	F2		
1.	Surface tension measurement	35.10 dynes/cm	34.18 dynes/cm		

➤ Foaming Ability & Foaming Stability:

Table C. Essening Ability	0- Eastering Ctalii	iter of a strong lles douise.	
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fuole 0. found form	y con building building	ity of maturing delive	a shampoo oar

	DURATION	FOAM VO	LUME	FOAM ST.	ABILITY
S.NO.	OF TIME	F1	F2	F1	F2
1.	0 min	45ml	48ml	Stable	Stable
2.	1 min	48ml	50ml	Stable	Stable
3.	2min	48ml	50ml	Stable	Stable
4.	3min	50ml	50ml	Stable	Stable
5.	4min	50ml	50ml	Stable	Stable



Fig 5: Foaming Ability & Foaming Stability

IX. CONCLUSION

The study aims to formulate a shampoo bar that is made from natural ingredients.

In this study formulation and evaluation of naturally derived shampoo bars, the shampoo bars were prepared using various naturally derived ingredients such as plant-based surfactants, oils, essential oils, and natural flavors. We have done two formulations, F1 and F2. The colour of both the shampoo bars was stubble yellowish brown, and had a pleasant odour. In terms of consistency of shampoo bars, F1 has no proper texture when compared to formulation F2. The pH of the Formulation F2 was found to be 5.5, which is almost the pH of the scalp. Dirt dispersion was good there was no deposition of ink in the foam. The foam volume was good and found stable. The final comparison reveals that formulation F2 has shown the ideal characteristics of the shampoo bar.

In conclusion, the formulated natural shampoo bars will have no significant side effects when compared to synthetic shampoo bars. The shampoo bars are eco-friendly, easy to use, and last longer than their liquid shampoos. Additionally, they are often made with natural and nourishing ingredients that can improve the health and appearance of the hair. The formulated shampoo bar has good hardness and foaming ability which are important for providing a satisfying user experience.

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