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Shampoo formulation with active ingredient candlenut oil (*Aleurites Moluccana*)

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Abstract

Background: Candlenut oil (*Aleurites moluccana*) is a natural ingredient rich in essential fatty acids and antioxidants that has potential benefits in hair care, particularly for strengthening hair roots and promoting hair growth. The development of candlenut oil-based shampoo offers an alternative natural and environmentally friendly cosmetic product.
Method: This experimental study formulated shampoo preparations containing varying concentrations of candlenut oil (6%, 12%, 18%, and 24%) and evaluated their physical characteristics through organoleptic testing, pH measurement, viscosity testing, and foam height analysis.
Results: Organoleptic testing showed that higher concentrations of candlenut oil produced a more intense yellow color, with a characteristic candlenut aroma and a soft texture in all formulations. The pH measurement indicated that all formulations were within the acceptable pH range for topical preparations (5–9). The foam height test demonstrated that increasing candlenut oil concentration reduced foam stability and foam height. The viscosity test revealed that only Formula 2 met the required viscosity standard (400–4000 cps), while the other formulations were below the acceptable range.
Conclusion: Based on the overall physical evaluation, Formula 2 (12% candlenut oil) demonstrated the most optimal characteristics and met the required quality standards for shampoo preparations.

Keywords: Formulation; Shampoo; Candlenut Oil; Physical Evaluation

INTRODUCTION

Shampoo is a cosmetic preparation designed to cleanse the hair and scalp while maintaining scalp health and minimizing irritation (1). The selection of appropriate excipients, particularly thickening agents, plays an essential role in determining the physical stability and user acceptability of shampoo formulations. Carboxymethyl cellulose (CMC) is widely used as a viscosity-enhancing polymer due to its hydrophilic properties, biodegradability, and compatibility with cosmetic formulations (2). These characteristics make CMC suitable for developing stable and environmentally friendly shampoo products. In line with the growing demand for natural-based cosmetics, candlenut oil (*Aleurites moluccana*) has gained attention as a potential active ingredient due to its essential fatty acid and antioxidant content, which contribute to hair nourishment and scalp protection. Therefore, CMC can be used as a thickening agent (viscosity agent) in shampoo formulations because of its hydrophilic properties which can increase the viscosity of the shampoo preparation, so that the texture is comfortable when used and increases the adhesion of active ingredients to the hair (3). Candlenut oil (Aleurites moluccanus) has been widely known as a natural ingredient in hair care (4). This oil is rich in essential fatty acids, including linoleic acid and oleic acid, which help moisturize the scalp and give shine to the hair (2). Candlenut oil also contains antioxidants such as vitamin E, which functions as a protector against free radicals and improves scalp health.

Candlenut oil (*Aleurites moluccana*) has traditionally been used in hair care due to its

nourishing and hair-strengthening properties (5). Its high content of essential fatty acids and antioxidant compounds supports scalp hydration and protects hair from oxidative damage (6,7). In cosmetic formulations, candlenut oil functions as a natural emollient, improving hair softness and manageability (8). The increasing consumer preference for plant-based and environmentally friendly cosmetic products has further encouraged the development of herbal shampoo formulations incorporating candlenut oil as an active ingredient (9). However, variations in oil concentration may influence the physical characteristics and stability of the shampoo preparation, thereby requiring systematic formulation and evaluation.

METHOD

Table 1. Formula

Material Name	F1	F2	F3	F4
Kemiri Oil	6%	12%	18%	24%
CMC Na	1 %	1 %	1 %	1 %
Nipagin	0,25%	0,25%	0,25%	0,25%
Propilen Glikol	10%	10%	10%	10%
Menthol	0,3%	0,3%	0,3%	0,3%
Oleum Rosae	2 gtt	2 gtt	2 gtt	2 gtt
Na Lauryl Sulfat	10%	10%	10%	10%
Aquadest	73,198 ml	63,118 ml	53,398 ml	43,498 ml

Prepare the tools and materials used, Weigh and take 2.29 cmc na for each formulation then develop in a mortar with 99 ml of distilled water, wait for the mucilage to form, Weigh and take 12 g of sodium Lauryl Sulfate for each formulation, add to the mortar, grind it smoothly and homogeneously. Dissolve methyl paraben into propylene glycol in a beaker glass, stir until homogeneous. Mix candlenut oil, oleum Rosae and menthol in a separate container, stir until homogeneous. Add the methyl paraben propylene glycol mixture into the mortar until homogeneous, Add the oil mixture (mixture into the water phase mixture slowly while stirring until homogeneous. Add the remaining distilled water to the desired volume, stir again until the shampoo is completely mixed, Put it in a well-closed container (10).

RESULTS

Table 2. Organoleptic testing

Evaluation	Evaluation Results			
	F1	F2	F3	F4
Color	Soft yellow	Yellow	Yellow	Yellow
Smell	Typical	Typical	Typical	Typical
Texture	Gentle	Gentle	Gentle	Gentle

Table 3. pH Test

Evaluation	Range	Evaluation Results			
		F1	F2	F3	F4
Replication 1	4-9	8.84	8.73	8.66	8.61
Replication 2		8.83	8.75	8.58	8.64
Replication 3		8.83	8.78	8.60	8.70
Average		8.83	8.75	8.61	8.65

Table 4. Foam height test

Evaluation	Range	Evaluation Result			
		F1	F2	F3	F3
Start	1.3-22 cm	5.6 cm	6.5 cm	6.5 cm	3.5 cm
30 second		4.5 cm	6.0 cm	6.1 cm	3 cm
2 minute		3.5 cm	5.5 cm	5.6 cm	2.9 cm
7 minute		3 cm	5.2 cm	5.5 cm	2.5 cm

Table 5. Viscosity Test

Evaluation	Range	Evaluation Result			
		F1	F2	F3	F4
R1: 12 RPM Spindle: 4	400-4000 cps/mpa.s (3)	108.6 mPa.s	432.1 mPa.s	505.2 mPa.s	341.5 mPa.s
R2: 30 RPM Spindle: 4		330.0 mPa.s	467.9 mPa.s	354.7 mPa.s	254.4 mPa.s
R3: 60 RPM Spindle: 4		377.3 mPa.s	552.7 mPa.s	351.4 mPa.s	340.5 mPa.s

DISCUSSION

1. Organoleptic testing

Organoleptic evaluation demonstrated that increasing the concentration of candlenut oil influenced the visual appearance of the shampoo preparation. Formula 1 (6%) produced a soft yellow color, whereas Formulas 2–4 (12–24%) showed a more intense yellow coloration. This finding indicates that the natural pigment of candlenut oil contributes directly to the color

intensity of the formulation as its concentration increases.

All formulations exhibited a characteristic candlenut aroma, suggesting that the fragrance (oleum rosae) did not completely mask the natural odor of the oil. However, the aroma remained acceptable and did not indicate phase separation or rancidity, reflecting good short-term physical stability.

In terms of texture, all formulas showed a soft and homogeneous consistency, indicating that the concentration differences of candlenut oil did not significantly affect the spreadability or physical uniformity of the shampoo. This suggests that the fixed concentration of CMC-Na (1%) was sufficient to maintain structural consistency across formulations.

Overall, organoleptic differences were primarily observed in color intensity, while aroma and texture remained relatively stable among formulas.

2. pH Test

The pH test aims to determine the acidity of a shampoo preparation, especially topical preparations (15). Topical preparations ideally have the same pH value as the skin's pH. This is because preparations that are too acidic will cause skin irritation and will give a stinging sensation, while preparations that are too alkaline will make the skin dry and itchy (16). The pH test data for all shampoo preparations meet the normal skin pH range for good topical preparations in the range of 5-9 (3). Based on this test, it shows that all of them are within the pH range of good shampoo preparations, which shows that the shampoo preparation does not indicating suitability for topical application and the skin pH has an effect on the absorption power of the preparation (11).

3. Foam height test

The foam height test was carried out to determine the resistance and strength of the foam (3). Based on the foam height test, it shows that the higher the concentration of candlenut oil, the lower the foam strength. The test showed that the stability of the foam decreased and was unstable. The higher the concentration of candlenut oil, the smaller the foam height produced because candlenut oil is hydrophobic and interferes with foam formation (10). So when added to shampoo in high concentrations, it will coat water molecules and surfactants, thereby interfering with the surfactant's ability to lower surface tension and reduce foam production (17).

4. Viscosity Test

The viscosity evaluation showed that only Formula 2 met the required standard range (400–4000 cps), while the other formulations exhibited lower viscosity values. This variation may be influenced by the concentration of candlenut oil in the formulation. At lower concentrations (Formula 1), the oil phase may not sufficiently contribute to structural reinforcement within the system, resulting in lower viscosity. Conversely, at higher concentrations (Formulas 3 and 4), excessive oil content may disrupt the internal structure of the aqueous polymer network, leading to instability and reduced viscosity.

In addition, the interaction between CMC-Na as a thickening agent and sodium lauryl sulfate (SLS) as a surfactant plays a crucial role in determining viscosity. CMC forms a hydrated polymer network in the aqueous phase; however, the presence of surfactants and hydrophobic oil components can alter polymer chain interactions. High oil concentrations may interfere with the micellar structure formed by SLS, thereby affecting the viscosity and flow behavior of the shampoo system.

These findings suggest that an optimal balance between oil concentration, polymer thickener, and surfactant is necessary to achieve stable viscosity, as observed in Formula 2.

CONCLUSIONS

Variation in candlenut oil concentration affected the physical characteristics of the shampoo formulations, particularly foam stability and viscosity. Formula 2 (12%) showed the most optimal balance of pH, foam performance, and viscosity within the required standard range.

Therefore, Formula 2 has potential for further development, including extended stability and safety evaluation to support its application as a natural-based shampoo product.

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