Preparation and characterization of herbal shampoo from goat milk and natural extract

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Abstract. Shampoo is one of the cosmetic type product using surfactants as the main compound which when used under the specified conditions will remove surface grease, dirt, and skin debris from the hairs without adversely affecting the user. Currently shampoo is not only used to cleanse dirt on the hair and scalp but also to hair growth and prevent hair loss. To achieve this goal, the shampoo industries used a variety of additives chemicals that can potentially risk for user. In this study, we tried to make two types of herbal shampoo using natural leafs extract. The formula of shampoo 1, consist of goat milk, celery leaf extract, banana knot extract, and pegagan leaf extract while shampoo 2 using goat milk, noni extract, mangkokan leaf extract and spinach extract. Both of that shampoo preparations were analyzed the physical appearance and physicochemical. The results showed that the physical performance both herbal shampoo were light brown in color, transparent and good odor while the physicochemical characteristics of herbal shampoo formula 1 comprise pH, solid content, surface tension and foam ability were 5.25; 29.17%; 51.17 dyne/cm and 9.50 mL, while herbal shampoo formula 2 has a pH of 5.5; solid content of 29.67%; surface tension of 44.63 dyne/cm and foam ability of 15.0 mL. Formulated herbal shampoo shows physicochemical properties comparable to the commercial shampoo.

1. Introduction

Hair acts to protect the scalp from extremely temperature and exposure to ultraviolet light. Besides that, hair is also a crown for humans. For this reason, hair requires special care to keep it smooth, shiny, difficult to broken and easy to combed. Shampoo is one of the cosmetic products that are used to cleanse the dirt that is attached to the hair and scalp. Shampoo is preparation using surfactant as the main ingredient and additional ingredients that are functioned to increase the working power of shampoo.

A various types of shampoos are available in market using the synthetic ingredients that are harmful to the skin and health in its formulation. However, most consumers are not aware of the side effects of these chemicals. Sodium lauryl sulfate is one example of surfactant which is rather hard when used excessively causing irritation to the scalp and damage to hair follicles. (Vozmediano, et al., 2010). Formaldehyde also frequently used as preservatives in shampoo formulations which lead to an increase in risk of dermal sensitization (Doi, et al., 2010).
The increasing level of human awareness of hazardous chemicals in cosmetic products for health, this makes consumers prefer herbal-based cosmetics compared to synthetic cosmetics. A various plants containing vitamins, phenolic, amino acids, and essential oils have been analyzed their potential for herbal shampoo formulations. Many plants are available naturally potential used for shampoos preparation such as Ziziphus spina leaves extract (Kadim, et al., 2011), saponins of Acanthophyllum squarrosum (Aghel, et al., 2007). The development of new cosmetic formulations is very important to evaluate the quality so that shampoo products are not harmful to hair and health. The main parameters commonly evaluated for shampoo were the stability of the volume of foam produced, pH, and surface tension (Mainkar and Jolly, 2000). In this study, the formulation of herbal shampoos using natural ingredients, i.e. goat milk and plant extracts such as mangkokan leaf, pegagan leaf, celery leaf, banana stalks, spinach leaf and noni fruit. Mangkokan leaf contain phenolic compound that acts hair loss prevention, while pegagan leaf contains amino acids, beta carotene, fatty acids, flavonoids, terpenoids, alkaloids, saponin used for anti-aging and increase the shampoo foam. Nutrient contents in celery such as vitamin A, vitamin B, sodium, iron and calcium can be used a hair nutrition (Wathoni, et al., 2018). Banana stems contain saponins, flavonoids, anthraquinones, vitamins, calcium and selenium. Anthraquinone is beneficial to nourish hair and loss hair prevention, while vitamins and minerals function to nourish hair. All herbal shampoos were evaluated by measurement of the physical appearance comprises odor, color and clarity whereas the physicochemical parameters including solid content, pH, surface tension, dirt dispersion, and foam stability.

2. Materials and Methods

2.1. Materials
The chemicals are used for shampoo preparation consist of texapon, sodium chloride, lexain-C, and lexard-P. While, the natural materials include goat milk and plant extracts such as mangkokan leaf, pegagan leaf, celery leaf, banana stalks, spinach leaf and noni fruit.

2.2. Methods

2.2.1. Preparation of Natural Extract. Each natural material sample is crushed into powder using a blender and then macerated using 70% ethanol (v / v) for 2 days. The liquid extract is filtered using filter paper and then concentrated by heating it at a temperature of 60°C. The concentrated extract of each natural ingredient obtained will be used as a mixture in making herbal shampoos.

2.2.2. Preparation of Herbal Shampoos. Herbal shampoos are made in the cosmetic industry in Singaraja-Bali. The composition of formulated herbal shampoos was shown in Table 1.

| Table 1. Composition of formulated herbal shampoo |
|-----------------------------------------------|
|       | Formulation 1 |       | Formulation 2 |       |
|       | Percentage (%) |       | Percentage (%) |       |
| Texapon | 20            | Texapon | 20            |
| NaCl    | 2             | NaCl    | 2             |
| Lexain-C | 3             | Lexain-C | 3             |
| Lexard-P | 1             | Lexard-P | 1             |
| Goat milk | 4             | Goat milk | 4             |
| Celery leaf extract | 4 | Noni fruit extract | 4 |
| Bananas stem extract | 4 | Mangkokan leaf extract | 4 |
| Pegagan leaf extract | 4 | Spinach extract | 4 |

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Chemicals for shampoo preparation namely texapon, sodium chloride, lexain-C and lexard-P were mixed in a container of stainless steel while stirring for 15 min. The goat milk and all natural extracts are also added to the mixture and stirred. The final volume was made to 100 mL with distilled water.

2.2.3. Evaluation of Herbal Shampoo. The herbal shampoos were evaluated by measuring the physical appearance such as color, odor and clarity whereas physicochemical tests for shampoo formulations including the determination of pH, solid content, and dirt dispersion. The results test were compared with commercial shampoo.

2.2.4. Physical Appearance. The formulated shampoos were evaluated qualitatively for their clarity, odor and color.

2.2.5. Determination of pH. The pH of 10% formulated herbal shampoo solution in distilled water was determined by using pH meter at room temperature.

2.2.6. Determination of Solid Content. A total of 4 grams of shampoo were placed in a curcible then heated at 600°C for 1 hour. Total solids are calculated by weighing the residue after complete heating.

2.2.7. Determination of Surface Tension. Surface tension of herbal shampoo was measured by using tensiometer at room temperature. The surface tension of water at same condition was also measured which used as a control.

2.2.8. Foaming ability and foam stability. A total volume of 50 ml of 1% shampoo solution is placed in a 50 mL burette, then the shampoo solution is poured into the test tube with the distance between the burette tip to the test tube was 50 cm. The total volume of foam is observed after 1 minute, and then the stability of the foam was evaluated by recording the volume of foam after remaining for 1 minute and 5 minutes.

2.2.9. Dirt dispersion. Two drops of formulated shampoo were added in a test tube contain 10 ml of distilled water. Two drops of red dyes was added into the test tube, then shacked for ten times. The amount of dyes in the foam was estimated as none, light, moderate, or heavy foam.

3. Results and Discussion
Comparative quality of the herbal and commercial shampoo were evaluated by performing of physical and physicochemical test.

3.1. Physical Appearance of Herbal Shampoo
Physical appearance is an important factor that greatly influences consumer interest in cosmetics. Our physical appearance of herbal shampoo was listed in Table 2.

| Shampoo          | Color     | odor | Clarity   |
|------------------|-----------|------|-----------|
| Formulation I    | light brown | good | Transparent |
| Formulation II   | light brown | good | Transparent |
| Commercial shampoo | white     | good | Clear     |

The two herbal shampoos were transparent and light brown color. It has a good odor given by the fragrance in the natural ingredients. The formulated shampoo was observed to be significantly different with commercial shampoo in terms of color and transparency.
3.2. Physicochemical Properties of Herbal Shampoo

Table 3. Physicochemical characteristic of shampoo

| Characteristic      | Units | Formulation I | Formulation II | Commercial Shampoo |
|---------------------|-------|---------------|----------------|-------------------|
| pH                  |       | 5.25          | 5.50           | 5.15              |
| Solid content %     |       | 29.17         | 29.67          | 29.45             |
| Surface tension     | Dyne/cm | 51.17        | 44.63          | 37.07             |
| Foam volume and foam stability |       | 9.50 mL     | 15.00 mL       | 13.30 mL          |

It can be shown in Table 2 that the pH of two formulated herbal shampoos was observed in range 5.25-5.5 for a while the pH commercial shampoo was 5.15. There is no standard pH for shampoo but most shampoo products have lower pH than or equal to 5.5 (Persaud and Kamath, 2004). The ideal pH for shampoo was at range 5.5 to 6 because it maintains the isoelectric point of hair creatine. The pH value of a shampoo greater than 6 will cause the hair to become dry and dull. However, the lower pH than 5 may be related to the emergence of skin irritation.

Mendhekar et al., 2017 reported that the percentage of solid content in a good shampoo is between 20 to 30%. Basically, the amount of low solid content will produce an aqueous formulation so it will wash out quickly. However, if the content of the solids is too much, it is too difficult to wash out (Krunali et al., 2014). In this study, the percent solid content of two herbal shampoos was found within range of 29.17-29.67%, whereas commercial shampoo has a solid content of 29.45% and are expected to wash out easily.

Surface tension indicates the amount of surfactant in the formulated shampoo to reduce the surface tension. Lesser the surface tension represent the stronger is the cleaning ability of the shampoo. A shampoo is in good quality when it can decrease the surface tension of pure water from 72.28 dyn/cm to about 40 dyne/cm (Al Badi and Khan, 2014). Herbal shampoos was made using natural extract comprise of celery, bananas stem and pegagan leaf (Formula 1) reduced surface tension to 51.17dyne/cm while using mangkokan, spinach and noni leaf extracts (Formula II) reduced surface tension to 44.63 dyne/cm. On the other hand, commercial shampoo reduced surface tension to 37.07 dyne/cm.

The ability of shampoo to dirt dispersion is an important factor for assessing the quality of shampoo. A good shampoo will be able to cause ink not to concentrate on the foam because ink or dirt that remains in the foam is difficult to rinse and will re-stick to the hair. The cleaning process of hair, the dirt must concentrate in the water to achieve a better cleaning action. All shampoo can push red ink in the water, so it can be ascertained that herbal shampoos can work effectively to clean up dirt.

Foaming is considered as important parameter in evaluation of shampoo. Herbal shampoo of formula I and formula II produced the foam volume about 9.5 and 15.5 mL while commercial shampoo generated foam volume about 13.3 mL. There was no significant change in foam volume in the 5 minute silencing period indicating that the resulting foam had good stability.

4. Conclusion

All the ingredients which are used to prepare the herbal shampoo are safe and the physicochemical evaluation of shampoo showed good performance. Formulated herbal shampoo shows physicochemical properties comparable to the commercial shampoo. Local plant extracts have great potential to be developed to produce good quality shampoo.

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