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Development of an Eco-Shampoo Formulation Using Local Environmental Plant Extracts for Healthy Hair

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Abstract

The potential of biological resources that are widely grown in Indonesia is underutilized by the community. Though these plants contain active chemical compounds that play an important role in nourishing body organs, skin and hair. The aim of this research is to develop an eco-friendly shampoo formulation (Eco-Shampoo) by adding local environmental plant extracts for hair health. This research method is a quasi-experimental development of existing shampoo formulations (base formulations) by adding local plant extracts such as aloe vera (*Aloe vera L.*) and Lemongrassoil (*Cymbopogon citratus*) in three formulations. The resulting shampoo products were then carried out two evaluations, namely the stability test (organoleptic test), foam height observation, viscosity test, pH test and preference test (hedonic test) by consumers to determine the feasibility and effectiveness of using shampoo. The results: after a storage period of 2 days showed: 1. Stability test, slightly changed color, constant odor, and texture did not change and the pH value was between 5.5 - 6.5, The smear test on the back of the hand and the skin behind the ear did not show skin irritation, whereas 2. hedonic test, there were 10 consumer consumers stated that

the color was like, the smell was stated like, and the texture was stated quite like it. Thus, aloe vera and coconut oil can be used as shampoo.

Key words: Formulation development, Eco-shampoo, plant extracts, local environment, health hair.

Introduction

Indonesia is a fertile country and has various types of plants. The soil is fertile and the rainfall is sufficient for various types of plants to grow and develop Arifin, 2006). Plants are biological natural resources that can be managed to become a source for the establishment of industries such as the pharmaceutical industry, the food industry, the metal industry, the animal feed industry, the plastic industry and the cosmetics industry. Several plants have been developed to treat hair problems, one of which is aloe vera and lemongrass leaves. Empirically, aloe vera leaves are used by the community to nourish their hair by using the inner gel of the leaf flesh (Ariyani & Haribi, 2009) . Likewise, lemongrass leaves are taken through extracts used by people for anti-dandruff hair treatment. Hair is one of the skin adnexas found throughout the body. Hair contains an important role for every human being. This is because hair can affect a person's appearance (Filbert, 2014)). The number of hairs on the human head is about 100,000 strands (Hotmauli & Melianda. 2010).

Even though hair has natural hair loss, for some people, hair loss is still a worrying thing. Hair loss can occur due to several factors such as age, hormonal disorders, pregnancy, drug use, continuous sun exposure, and lifestyle (Doughari, 2006)). To overcome hair problems, intensive care is needed, such as using shampoo, hair tonic, haor mask, hair oil, vitamins and others.

Environmental factors that have been polluted in urban areas can cause disruption of hair health. Air or water impurities that hit the hair of the head will cause dandruff. Dandruff is a

dry form of seborrheic capitis known as seborea sika (dry), which is dry, fragile, easily detached scales that stick to cover the epidermis of the scalp (Arrifin, 2006). One of the causes of dandruff is fungus on the scalp which is dirty due to sweat, sebum (oil) glands, and dust. The fungus that develops on the scalp is called Pityrosporun ovale (Ariyani & Haribi, 2009).

Symptoms of dandruff mainly include itching, flaking and redness of the scalp. This fungus is naturally found on the scalp and can attack humans at all ages. Many anti-dandruff shampoos contain antifungal compounds such as: sulfur, salicylic acid, selenium sulfide, and zinc pyrithione which have the effect of damaging the scalp and causing hair loss (Trueb, 2007). Therefore, there needs to be other alternatives, especially natural ingredients that can be used as dandruff anti-dandruff. lemongrass (*Cymbopogon citratus*) is one of the essential oil-producing plants. in Indonesia, this species is usually used as a mixture of herbs and spices because it has a distinctive aroma like lemon (Boome, et al., 2011). Lemongrass oil is one of the most important types of essential oil. This essential oil is used to produce citral which is the main constituent of lemongrass oil. Lemongrass oil is a pale yellow liquid which has a strong lemon smell due to its high levels of citral (65% to 85%) making it the most important ingredient in the pharmaceutical and cosmetic industries (Saputro, 2006). The main constituents of lemongrass essential oil are citral (3,7-dimethyl- 2,6-octadiental), a mixture of geranial (trans-citral A) and neutral (cis-citral B) with small amounts of geranium, geranyl acetate and monoterpene olefin (Aghel, et al., 2007).

Among the plants that can be used as hair growers is aloe vera. Aloe vera is very effective for hair care because it has a composition similar to keratin, an important hair protein, and complex amino acids identical to hair follicles so that it can rejuvenate hair with the same nutrients, especially the content of the amino acid L-lysine which can help in growth hair

(Limbani, et.al., 2009) . According to Daisy (2011)), the main elements of aloe vera liquid are aloin, emodin, resin, gum and other elements such as essential oils. In terms of nutritional content, aloe vera leaf gel or mucus contains several minerals such as Zn, K, Fe and vitamins such as vitamins A, B1, B2, B12, C, E, inositol, folic acid and cholin (Poutluri, et.al, 2013). Aloe vera is also a natural remedy that helps regulate the rich blood supply to the root hair follicles on the scalp, thereby helping to strengthen hair (Pooja & Maninder, 2011).

The concept of back to nature has been widely known among people and ecosystems. The use of plants as medicine has long been known by Indonesians as traditional medicine (Noreem, 2017). Treatment using traditional medicine today is very popular and is increasingly favored by the community. This is because affordable prices are easy to obtain and also have relatively few side effects (Naitullah, et al., 2014; and Pan, et.al,, 2009). In addition, Indonesia is also the second megabiodiversity country after Brazil, where it is estimated that there are 30000 species of living plants in the Indonesian archipelago and at least 9600 species are known to have medicinal properties (Indonesian ministry, 2007 and Robinson, 1995).

The cosmetic industry in Indonesia has developed around the 1950s. Previously, traditional cosmetics had developed among kings in Java (Mahatarani & Asriningdhiani, 2012). The Indonesian people at that time developed a complex of local plant ingredients that were used as powder, shampoo and herbal medicine. The use of traditional cosmetics at that time was still limited among the royal family alone. Along with the development of chemistry, pharmaceutical science and medical science, cosmetics and industrial sciences have also developed (Mitsui, 1997).

Now the cosmetics industry is growing rapidly in accordance with the demands of modern society. The cosmetic industry is more developed using chemicals such as paraffin, surfactants, dyes, and preservatives.

As public awareness of environmental issues has increased, such as green products, environmentally friendly products, and herbal products, the cosmetics industry has begun to compete with industrial expansion related to environmentally friendly cosmetic preparations (Deeksha & Sharma, 2014) . However, not all the basic ingredients in the manufacture of the cosmetics industry have been replaced by natural ingredients, such as foam, thickeners and preservatives. More active ingredients can be substituted by natural ingredients such as protein, dyes, and other nutrients (Aghel & Dana, 2017).

Many cosmetic companies in Indonesia produce shampoo, such as the Wahdah industry. Therefore, the formulation of the research problem arises: (1) Can the manufacture of shampoo be developed with local plant materials such as aloe vera and lemongrass oil? (2) How to evaluate shampoo preparations made from aloe vera and lemongrass oil? . The objectives of this study were (1) to determine the formulation of shampoo that was given a mixture of aloe vera and lemongrass oil, and (2) to determine the evaluation results of shampoo preparations mixed with local plants such as aloe vera and lemongrass oil.

Materials and Methods

The tools used in this research are measuring cup (Pyrex), beaker glass (Pyrex), Erlenmeyer (Pyrex), test tube (Pyrex), 65 mash sieve, spatula, stirring rod, glass funnel (Pyrex), separating funnel (Pyrex) . Petri dishes (Pyrex), analytical scales, blenders, hot plates, porcelain cups, shampoo containers, clamps and statives, pipettes, pH meters, filter paper, sterile gauze, and bunsen lamps.

The materials used in this research are aloe vera, lemongrass oil, sodium lauric sulphate, Cocamide DEA, CMC, menthol, citric acid, methyl paraben, aquadest, sodium chloride (NaCl).

Aloe vera samples are purchased at supermarkets, as is slow mass oil. The initial stage is to collect fresh aloe vera leaves. Then the fresh aloe vera leaves are washed under running water

to remove the dirt. The contents of the aloe vera gel are taken, then crushed then filtered with a poach to get a smooth and non-clumping gel.

This research method is an experiment, which is carried out in the chemistry laboratory of the Faculty of Engineering, State University of Jakarta. The ingredients used are Sodium Lauril sulphate, Aloe vera, lemongrass oil, aquadest,

This research method is a experimental development of existing shampoo formulations (base formulations) by adding local plant extracts such as aloe vera (Aloe vera) and Lemongrass oil (Cymbopogon citratus) in three formulations.

Table 1 Shampoo Formulation for Lemongrass and Aloe Vera Oil Fractions.

Ingredients	Shampoo Formulations with Various Fractions of Lemongrass and Aloe Vera Oil		
	F1	**F2**	**F3**
Lemongrass Oil	2%	7%	12%
Aloe vera	3%	3%	3%
Sodium Lauric Sulphate	10%	10%	10%
Cocamide DEA	4%	4%	4%
CMC	3%	3%	3%
Citric Acid	q.s.	q.s.	qs.
Menthol	0.5%	0.5%	0.5%
Methyl Paraben	0.15%	0.15%	0.15%
Aquadest	Ad.30 mL	Ad.30mL	Ad.30mL

Source: (Al Badi & Khan, 2014; Mitsui, 1997)

The formulation results were tested for homogeneity, PH, viscosity, foam density and foam stability, wetting time and cleaning power test. Homogeneity testing using a glass object. Anti-dandruff shampoo gel is made of a 10% solution and measured the pH using a pH meter. Viscosity check is done using a viscometer. The foam power test was carried out by making a 10% shampoo gel solution, shaken 10 times and recorded the volume of foam

formed (Munro, 1954; Fazlolazadeh, 2015). The foam stability test is done by recording the volume of foam reduction that occurs in the foam power test in 1-4 minute intervals (Deeksha & sharma, 2014). The wetting time test was carried out by making a 1% shampoo gel solution then put it in a measuring cup and the canvas cloth was dropped into the solution. Measure the time it takes for the canvas to sink.

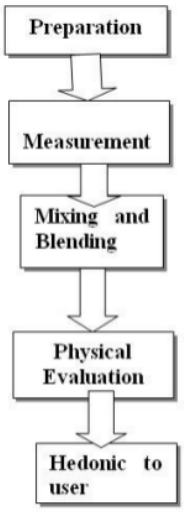

Figure 1 Diagram of the Process of Making Shampoo with Local Plant Mixtures

Weigh all the ingredients used according to the formulation. CMC is developed with hot water in a mortar. Diluted methyl paraben with a few drops of ethanol until dissolved. Part of the aquadest is heated on a hot plate at 60^{o}C and added with sodium lauryl sulfate, stirring until homogeneous. Cocamide DEA was added to the mixture while continuing to stir, until it was homogeneous. (Mitsui, 1997)

Result and Discussion

Based on the results obtained, the distilled water fraction has the greatest fungal inhibiting activity so that anti-dandruff shampoo preparations are made using active ingredients, namely the distilled water fraction of aloe vera leaves and lemongrass oil with a concentration of 5%,

10% and 15%, surfactants, and additives. The surfactants chosen in the manufacture of this shampoo are the surfactants that are widely used in shampoo preparations on the market, namely sodium lauryl sulfate as the primary surfactant and cocamide DEA as a secondary surfactant. By using primary and secondary surfactants, dandruff shampoo preparations can clean and form foam better. Additional ingredients used are CMC as a thickener, Methyl paraben as a preservative, Citric acid as a buffer and Menthol as a fragrance. The anti-dandruff shampoo for the aloe vera leaf fraction was evaluated to determine its quality and safety. Then proceed with testing the antifungal activity of the anti-dandruff shampoo preparation.

The results of organoleptic observations of the anti-dandruff shampoo for aloe vera leaf and lemongrass oil fraction with various concentrations showed that the higher the concentration of aloe vera leaf aquades fraction contained in the anti-dandruff shampoo preparation, the stronger the distinctive odor of aloe vera leaves and lemongrass oil so that it covers the odor of the menthol fragrance. used, and the darker brown in the shampoo preparation because of the red brick color of the citronella leaf aquades fraction.

The pH test aims to determine the safety of the preparation at the time of use. Shampoo pH that is too acidic or too alkaline will irritate the scalp. Based on the results of pH measurements using universal pH indicator paper, the addition of aloe vera and lemongrass distilled fraction causes a decrease in pH due to the influence of active substances in aloe vera distilled water fraction which has an acidic pH. Although the pH of the shampoo decreased, the pH value of the three anti-dandruff shampoo formulations still met the requirements set forth in SNI No. 06-2692-1992 which is around 5.0-9.0.

The foam height test aims to show the surfactant's ability to form foam. The lather from the shampoo is very important. This is because the foam keeps the shampoo in the hair, makes hair easy to wash, and prevents the hair sticks from sticking together, causing tangles (Mitsui,

1997). The foam height resulting from the three shampoo formulations has increased foam power. This increase was caused by an increase in the distilled water fraction in the shampoo preparation because the distilled water fraction of aloe vera leaves and lemongrass contained saponins. According to Harbone (1996) saponins are soap. The foam height test results of the three shampoo formulations met the foam height requirements according to Wilkinson (1982), namely 1.3-22cm.

Testing the value of water content is very important to do in a shampoo product, because the moisture content is related to the physical shampoo and affects the shelf life of a shampoo product. From the measurement of water content, anti-dandruff shampoo with various concentrations of aloe vera and lemongrass distilled water still meet the requirements according to the requirements of SNI No. 06-2692-1992 which is a maximum of 95%. Based on the results obtained, the water content produced, the greater the concentration of the fraction added, the smaller the percentage of water content obtained. This higher water content comes from materials that are hygroscopic (the ability of a substance to attract water molecules from its environment), such as CMC.

Table 2. Results of Organoleptic Observations for Mixed Aloe Vera Shampoo and Lemongrass Oil.

Shampoo Preparation formulations	Observation Result		
	Shape	Colour	Smell
F1	liquid, nothing settles	Light Brown	Menthol, and lemongrass
F2	liquid, nothing settles	Brown	Menthol, and lemongrass
F3	liquid, nothing settles	Dark Brown	Menthol, and lemongrass

Table 2. pH Scale Measurement

Shampoo Preparation formulations	pH
F1	6
F2	5.5
F3	5.5

Table 3. Foaming Hight Measurement

Shampoo Preparation formulations	Foaming Hight
F1	6.2
F2	7.3
F3	8.1

Table 4. Results of Measurement of Water Level Content for Shampoo Preparations

Shampoo Preparation formulations	Water Level (%)
F1	89.83
F2	86.71
F3	82.36

The shampoo preparations made in this study used active ingredients which is obtained from the water girlfriend leaves. Water girlfriend leaves that are taken cleaned and washed under running water to remove dirt. The leaves are already aerated and put in the oven to reduce moisture content in the leaves .. The dried leaves of Aloe vera are then blended until smooth and sieved in order to obtain a homogeneous powder with a surface area. large so that it facilitates the release of active substances in the extraction process. The results of aloe vera leaf extract were obtained from the extraction process with using maceration method and 96% ethanol solvent. This maceration method also has the advantage of being able to maintain the compound content in the sample which is not heat resistant, undamaged and the

sample can be extracted directly in large numbers (Doughari, 2006). This sample extraction using 96% ethanol solvent because ethanol solvent covers almost the entire content simplicia, both non-polar, semi-polar and polar (Iswanti, 2009).


Figure 2. The process of making shampoo from aloe vera and lemongrass oil and shampoo preparation.
Sourse : Laboratory data, 2019

The concentrated extract that has been obtained is then fractionated by the method partition using n-hexane, ethyl acetate and distilled water. Use of solvents aims to attract compounds in the extract based on the level polarity. Based on the yield of the extract fractionation, it can be seen that the distilled water solvent fraction had the highest yield. This shows that it is deep.

Based on the results obtained, the distilled water fraction has activity inhibits the most fungus so that anti-dandruff shampoo preparations are made with using the active ingredient, namely the aquades fraction of Aloe vera leaves and lemongrass oil with concentration 5%, 10% and 15%, surfactants, and additives. Surfactants are selected in This shampoo is a surfactant which is widely used in shampoo preparations on the market, namely sodium lauryl sulfate as primary surfactant and cocamide DEA as a secondary surfactant. By using primary surfactants and secondary, anti-dandruff shampoo preparations can clean and form more foam well (Deeksha & Sharma, 2014). Additional ingredients used are CMC as a thickener,

Methyl paraben as a preservative, citric acid as a buffer and menthol as a fragrance. Shampoo anti-dandruff fraction aquades leaves aloe vera that has been finished evaluated for know the quality and safety. Then proceed with testing

the antifungal activity of the anti-dandruff shampoo preparation.

The results of organoleptic observations of anti-dandruff shampoo for leaf aquades fraction Water girlfriends with various concentrations show that the higher Concentration of water Pacar leaf aquades fraction contained in the shampoo preparationanti-dandruff, the stronger the distinctive smell of Aloe vera leaves so that it covers the smell of the menthol fragrance used, as well as the darker brown in the preparation shampoo because the color of the distilled water of Aloe Vera leaves is brick red. The pH test aims to determine the safety of the preparation at the time of use. Shampoo pH that is too acidic or too alkaline will irritate the scalp.

Based on the results of pH measurements using universal pH indicator paper, addition of the distilled water fraction Aloe vera causes a decrease in its pH due to the influence of the active substance in the aquades water Pacar fraction which has an acidic pH. Although the pH of the shampoo has decreased, the pH value of the three shampoo formulations

anti-dandruff that still fulfills requirements stipulated in SNI No. 06-2692-1992 which is around 5.0- 9.0. The foam height test aims to show the surfactant's ability forming foam. The lather from the shampoo is very important. This matter because the lather keeps the shampoo in the hair, making hair easy washed, and prevents the hair sticks from sticking together to cause tangled (Mitsui, 1997). High foam resulting from the three shampoo formulations experienced increased foaming. This increase was caused by the increase in the distilled water fraction in the shampoo preparation was due to the distilled water fraction of the leaves Water girlfriend contains saponins. According to Harbone (1996) saponins are soap.

The foam height test results of the three shampoo dosage formulations met the high requirements foam according to Wilkinson (1982) is 1.3-22cm.

Test the value of water content is very important to do in a product shampoo, because the water content is related to the physical shampoo and affects the shelf life a shampoo product. From the measurement of water content, anti-dandruff shampoo with various concentrations of water Pacar leaf aquades fraction still meet the requirements according to the requirements of SNI No. 06-2692-1992 which is a maximum of 95%. Based on the results obtained the resulting water content, the greater the concentration of the fraction added, the smaller the percentage of water content obtained. Water content higher this comes from materials that are hygroscopic (the ability of a substances to attract water molecules from the environment) such as CMC. Anti-dandruff shampoo preparations with various concentrations were tested its activity against the growth of the fungus *Candida albicans* by using media, method, fungus and positive control were the same as those used on antifungal activity testing of the previous extracts and fractions. Negative control Anti-dandruff shampoo formula is used without the aquadest Aloe vera leaf fraction (base shampoo). Negative control is used to determine whether there is a basis effect shampoo against the growth of the test fungi, so it can be seen that the activity shown by the shampoo with various concentrations of leaf distilled water. Aloe vera is the substance contained in the distilled water fraction shampoo preparations and not derived from the shampoo base used (Pothuri, et.al., 2013).

The results of testing the antifungal activity of anti-dandruff shampoo, distilled water fraction. Aloe vera and lemongrass oil with concentrations of F1 (5%), F2 (10%), F3 (15%), shampoo formula anti-dandruff without distilled water fraction of Aloe Vera leaves as negative control and shampoo (June, 2016).

Ketoconazole 2% as a positive control in each treatment indicates a zone of inhibition that has formed around the well. Obstacles zone the largest indicated by the anti-dandruff

shampoo with a concentration of 5% distilled water, followed by anti-dandruff shampoo with concentration of 10% distilled water and zone fraction The smallest inhibition was shown by anti-dandruff shampoo with fraction concentration 15% distilled water with an average size of the inhibition zone in a row, namely 13.83 mm, 9 mm and 7.83 mm. The difference in inhibition is influenced by the addition of distilled water fraction which affects the release of active substances for inhibits fungus (Aghel, et.al., 2007) The higher the concentration of distilled water, the thicker it is anti-dandruff shampoo preparation, the greater the viscosity of the shampoo preparation. Viscosity is a statement about the resistance of a liquid to flow, the higher the viscosity, the greater the resistance (Al Badi & Khan, 2014). This is what make so that it blocks the release of the active substance which results in inhibition the fungus Candida albicans is decreasing.

Conclusion

Based on the results of research on the physical stability test of mixed aloe vera and lemongrass oil shampoo with varying concentrations, namely 5%, 10% and 15%, it can be concluded that aloe vera contains active compounds, fats, carbohydrates, and proteins. Aloe vera fraction and lemongrass oil can be formulated as a shampoo preparation to maintain hair fertility as well as an anti-dandruff shampoo that meets requirements such as organoleptic, pH, high foam and moisture content. Evaluation of shampoos for quality assurance is a physical appearance test that is attractive, homogeneous, does not break and is able to form foam. The pH value ranges from 5 - 6. The test for the ability and stability of the foam of the shampoo is carried out using the Cylender Shake method at 6-8 cm, where the formulation of aloe vera is 3% and lemongrass oil is 12%.

Suggestion

It is necessary to carry out further research to test the viscosity and determination of surfactant levels as well as to test the safety of shampoo preparations on animal skin.

Knowledgment

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