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Formulation and Evaluation of O/W Body Cream Containing Patchouli Oil (*Pogostemon cablin Benth.*) and Drumstick Oil (*Moringa oleifera*) as Potential Moisturizing Agent

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Abstract: Various compounds and extracts obtained from a wide variety of plants can be employed as natural antioxidants in cosmetics applications. Patchouli oil (*Pogostemon cablin Benth.*) and drumstick oil (*Moringa oleifera*) have the ability to fight free radicals and keep skin hydrated, making them excellent candidates for usage as an active component in cosmetic goods like body cream. This research aims to determine the physical quality of a body cream formulation by subjecting it to an accelerated stability test technique for seven cycles. The preparation was evaluated in each cycle, and the results were analyzed using student's t-test. The evaluation results of body cream preparation showed that there was no significant difference ($p>0.05$) in the preparation during each cycle. As a result, the formulation of the body cream remained stable throughout the storage term of at least six months, which indicates that it can be utilized for an entire year when kept at room temperature. After two weeks of application on dry skin, it was demonstrated that the formulation had the capacity to increase the amount of moisture contained in the skin (from 30% to 60%). In conclusion, the formulation is potentially produced as commercial cosmetic product in the future.

Keywords: Body Cream; Cosmetics; Drumstick Oil; Patchouli Oil; Moisturizing Activity

Introduction

Patchouli is one of the traditional plantation commodities of Aceh, and it has the ability to be cultivated in practically all sections of the province (Isnaini et al., 2022). Geographically and agronomically, this location has comparative advantages and is particularly ideal for patchouli cultivation; therefore, it is not surprising that the quality of patchouli oil from Aceh is quite good and has even been declared the world's number one quality (Muhammad et al., 2022). Several reports indicate that Indonesia presently meets roughly 85%-90% of the global demand for patchouli oil, with an average export volume of 1,057 tons per year (Dantas, 2020; Rahmayanti et al., 2020; Maulia and Basyah, 2021). Of this amount, the contribution of Aceh patchouli oil is only around 15-20 percent (Hasanah and Agus, 2019). This is significantly lower than Aceh's oil contribution in the 1980s, which reached 80-90 percent of Indonesia's patchouli oil supply. The decline in the supply of patchouli oil in Aceh is almost the same as the general constraints in other regions in Indonesia, including the low yield of patchouli oil obtained, the quality of the oil is low and varied due to lack of attention to quality control, and provision of products is not continuously, and prices fluctuate (Desiyana et al., 2023; Irmayani et al., 2022; Rinaldi et al., 2022; Vonna et al., 2020; Yusnidar et al., 2021).

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Apart from the patchouli plant, *Moringa oleifera*, a member of the Moringaceae family, is one of the most advantageous underused food products grown in many tropical nations. The most well-known of the 13 species in the genus Moringaceae is *Moringa oleifera,* known as drumstick (Susanti and Nurman, 2022). Drumstick is a versatile plant that can be used for both nutritional and therapeutic purposes. It has a wide range of medicinal benefits in addition to a wealth of nutritional value (Arumugam et al., 2023). Drumstick oil is also referred to as "ben oil" since it has a high concentration of behenic acid (Adegbe et al., 2016). The oil has a fatty acid content that is quite comparable to olive oil and is high in unsaturated fatty acids. Oleic acid, which makes up 57% of the mono-unsaturated fatty acids in the moringa plant, is also present in considerable amounts, as are polyunsaturated fatty acids (omega-3, 13.28%) and bioactive substances (Cheenpracha et al., 2010). Kessler et al. (2023) reported that drumstick oil is a promising new resource for developing various skincare products due to its high concentration of bioactive chemicals.

Body washes, gels, creams, exfoliants, moisturizers, toners, toothpaste and sunscreens from herbal extract are some of the many different types of skincare products that can be purchased to address practically any cosmetic condition that a person might have (Awaluddin et al., 2023; Isnaini et al., 2023; Junuda et al., 2023; Khairi et al., 2023; Sulastri et al., 2023; Kusmayadi et al., 2023). The primary concern is providing assistance to the skin from the inside out. For this reason, the Food and Drug Administration (FDA) was established to prevent the use of known harmful substances, but despite this, many skincare products nevertheless have negative side effects. Ever since the beginning of time, creams and other topical preparations have been regarded as an essential component of cosmetic items. Creams could be regarded pharmaceutical items due to the fact that even cosmetic creams are based on techniques developed by pharmacies, and even unmedicated creams are widely used to treat a wide range of skin diseases (Adiaksa et al., 2023; Chauhan and Gupta, 2020; Mawazi et al., 2022; Rai et al., 2019).

In the past, creams were made by simply combining two or more components with water, which served as the medium for the mixing. Because of advances in technology, traditionally-made creams have given way to more modern approaches to their production. The public and the community at large can employ these semisolid preparations in an elegant manner. They are able to perform a wide variety of functions. Creams are extremely versatile and can be used on virtually any part of the body. Everyone, regardless of age, can benefit from using cream because of how easy it is to apply. Although it works just as well with non-aqueous items like wax-solvent based mascaras, liquid eye shadows, and ointments, it is most commonly used with aqueous substances. Emulsions of oil and water (o/w) are what make up creams. This research aims to determine the physical quality of a body cream formulation by subjecting it to an accelerated stability test technique for seven cycles. The preparation was evaluated in each cycle, and the results were analyzed using student's t-test.

Method

In this investigation, a light proportion of patchouli oil was incorporated into the production of body cream, containing drumstick oil, in the role of acting as a moisturizing agent. Niacinamide and drumstick oil, which functions as a skin brightener, and patchouli oil, which acts as an antibiotic and may be used on sensitive facial skin types, are both included in the formulation of the body cream, which uses only the finest components. The schematic research procedure is shown in Figure 1.

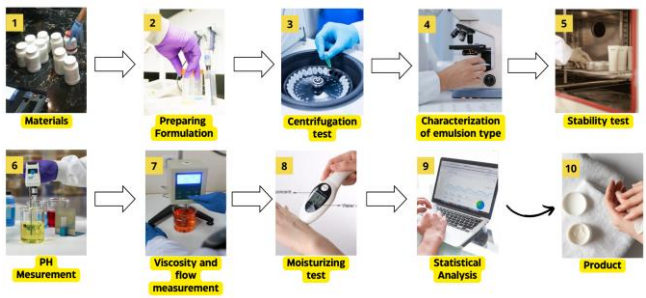

Figure 1. The schematic research procedure.

Materials

In order to create this body cream, the following pieces of machinery were required: a hot plate, scales, a magnetic stirrer, a stirring spoon, a measuring cup, a baking glass, and a dropper. Mineral oil, dimethicone, cetyl alcohol, stearic acid, polysorbate 60, patchouli oil light fraction, drumstick oil, glycerin, propylene glycol, carbomer, and distilled water are the components that go into the production of this sunscreen. Other components include patchouli oil heavy fraction and polysorbate 80.

Preparation of formulation

The process of making the body cream begins with the weighing of all of the required components. Next, the oil phase (mineral oil, dimethicone, cetyl alcohol, stearic acid, polysorbate 60, patchouli oil light fraction, and drumstick oil) is placed in a beaker glass and heated to 70^{o}C until it has melted. The aqueous phase, which consisted of glycerin, propylene glycol, carbomer, and distilled water, was transferred to a different glass

beaker and heated to a temperature of 50°C. After reaching a temperature of 50°C, the liquid phase is then put into the phase consisting of melted oil, and the two phases are then homogenized with a mixer until they reach a temperature of 30°C ± 2°C. After adding the tocopherol acetate, phenoxyethanol, color, and fragrance, whisk the mixture until it is completely combined. There were two types of formulation, such as F0 (blank formulation, without active ingredients) and F1 (with active ingredients).

Physicochemical properties of formulation
Centrifugation test

An evaluation of the formulations' ability to withstand repeated centrifugation at a speed of 3,000 rpm for a period of thirty minutes was carried out. Following this, macroscopic observation was used to observe both the appearance and the phase separation.

Characterization of emulsion type

A microscopic observation (using a light microscope) with Ponceau 4R aqueous solution and a conductivity measurement (using a conductivity meter model CM-115 manufactured by Kyoto Electronics Manufacturing Co., Ltd. in Kyoto, Japan) were used to determine the type of emulsions that were prepared. The preparations were one day old at the time of these tests.

Stability test

In order to determine the physical quality of the preparation of body cream, an accelerated stability test was carried out. After being incubated at 4 degrees below zero for twenty-four hours, the body cream formulation was then transferred to a temperature of forty degrees below zero for an additional twenty-four hours. This procedure is repeated until the seventh cycle has been completed (Sabrina and Ratri, 2017). Each time completed; it is counted as one cycle. During each cycle, alterations in organoleptic, homogeneity, pH, dispersion, and adhesion properties were found.

pH measurement

The pH of the formulations was determined using a digital pH meter at room temperature (30°C ± 2°C), (n=3).

Viscosity and flow measurement

Using a bob-cup Brookfield rheometer (model LVDV-III Ultra, Brookfield Engineering Laboratories Inc., MA, USA) and a tiny adaptor, the viscosity and rheological characteristics of the formulations were evaluated. Spindle SC4-31 was the one that was utilized. All of the measurements were taken with the temperature set at 30°C ± 2°C (n=3).

Moisturizing test

In order to participate in the study, female subjects had to be between the ages of 20 and 40 and have an extremely dry skin type. In the event that a subject had an acute skin disease, general illness, skin irregularities (such as scars, tattoos, or wounds), or was using any medication or topical treatments that could hinder or jeopardize the subjects or the performance of the study, they were not allowed to participate in the research. Participants who had a history of an allergy or sensitivity to any cosmetic product, any ingredient in a cosmetic product, latex, plaster, or any other substance used in the study were not allowed to participate. It was determined that research that did not involve the use of drugs should adhere to the recommendations made in the Declaration of Helsinki as well as the guidelines for Good Clinical Practice developed by the International Conference on Harmonization. Every participant in the research gave their verbal and signed informed consent to take part in the study.

Statistical Analysis

The data were presented using mean and standard deviation (SD) as their respective expressions. The student's t-test was carried out by SPSS statistics 22 (SPSS, Cary, North Carolina, United States), and the results were compared statistically. Differences that had a p-value of less than 0.05 were regarded as being statistically significant.

Result and Discussion

Physicochemical properties of formulations
Centrifugation test

After 30 minutes of centrifugation at 3,000 rpm, all compositions were still homogeneous. The produced creams were therefore regarded as stable in this experimental setting. According to some reports, the solubility of the active ingredient can be affected when two phases in an emulsion system are separated, although this is not the case in the current study (Mhatre et al., 2015; Cortés-Morales et al., 2021; Singh et al., 2022).

Characterization of Emulsion Type

According to Anton et al. (2018), the term "cream" refers to a type of formulation that contains a significant amount of water. The amounts of water contained in the produced creams ranged from 44.80% w/w to 48.80% w/w on a weight-percentage basis. According to Shoghl et al. (2016) and Feng et al. (2023), the ability of water to allow an electrical current to flow through it is connected with its electrical conductivity. According to the findings of Table 1's conductivity value summary, the high values showed that the emulsions were of the o/w type. It was found that there was a correlation between

the pH values of the formulations and the rising conductivity value that occurred from formulation F0 to formulation F1. According to Amani et al. (2017), the levels of conductivity might be affected by the negative charge of the ions present in the formulations. The conductivity values of F0 and F1 differed significantly ($p>0.05$), indicating that the difference was statistically significant. The emulsion system was determined to be o/w as a consequence of the findings of microscopic inspection performed using a light microscope. The aqueous solution of Ponceau 4R had a red color, and it was found in the external phase, which was water. In every composition, the oil droplets that made up the internal phase appeared to be a variety of sizes. It is advisable to use a homogenizer with a high speed in order to achieve more homogenous droplets.

pH measurement

pH values of the formulations that contained patchouli oil and drumstick oil were considered to be within the range of pH values that are found in skin (Ono et al., 2015). The result was showed a good sign of low irritant product.

Table 1. pH and electrical conductivity values of formulations

Parameters	F0	F1
pH value	6.45 ± 0.03	7.25 ± 0.21
Electrical conductivity (µs/cm)	150.55 ± 1.22	167.42 ± 1.31

(mean ± SD, n=3, where n is number of samples)

Viscosity and Rheological Measurement

Figure 2 illustrates the formulation's texture on application. In general, when the shear rates were increased, the cream viscosity tended to decrease. It appeared as though the produced creams had a shear-thinning system, also known as a non-Newtonian flow. As the shear rates increased, the formulations went from having a higher viscosity to having a lower one. The viscosity of F0 and F1 did not statistically differ from one another ($p> 0.05$) when tested at speeds of 45, 60, and 90 revolutions per minute. According to Garcia-Olvera et al. (2016), the high number of organic acids in the oil was likely the reason of the lower viscosity of F1, which contained patchouli oil and drumstick oil. The formulations that contained patchouli oil and drumstick oil had viscosity values that were significantly lower than 1,000 cps. Therefore, it is anticipated that they will be simple to apply to the surface of the skin.

Figure 2. Texture of body cream containing patchouli oil and drumstick oil

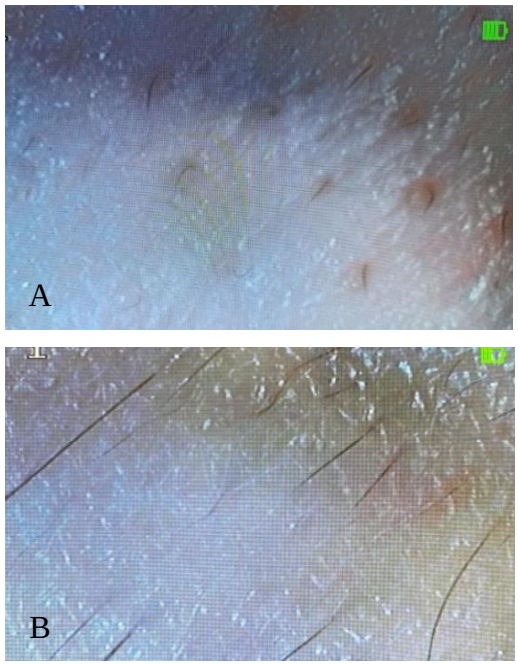

Figure 3. (A) Skin texture before body cream application (moisture content: 30%); (B) Skin texture after body cream application (moisture content: 60%)

Moisturizing test

In the earliest clinical trials, it was found that treatment with glyceryl glucoside in an emulsion formulation greatly decreased trans epidermal water loss (TEWL). In this study, formulations that contained glyceryl glucoside in addition to NMF and ceramide 3 were seen to not only considerably reduce TEWL (which indicated enhanced barrier function), but also significantly improve skin hydration with daily usage. This improvement was maintained when the product was discontinued as shown in Figure 3. These product compositions offer a comprehensive and improved treatment for xerosis, since they aid the skin's natural self-repair processes and work to strengthen the skin barrier. As a result, the authors would argue that a good moisturizer does not simply provide the skin with substances to replace those of which it is lacking, but rather creates an environment that is physiologically compatible with the skin and enables the skin to repair

itself. These products contain glyceryl glucoside, which helps supply water to the stratum corneum, ceramide, which helps reinforce the lipid barrier, and a number of components of the natural moisturizing factor (NMF), such as urea and others, which moisten and help promote barrier repair. These one-of-a-kind and innovative formulations, which were designed to hydrate the skin through a variety of different processes, appear to encourage the self-repair of the barrier and constitute a new strategy for the treatment of xerosis.

Conclusion

According to the findings, both patchouli oil and drumstick oil were able to be successfully blended into o/w body cream. On the basis of macroscopic observation as well as pH and viscosity readings, it was determined that the creams containing tamarind fruit pulp extract had satisfactory physicochemical properties. These loaded creams also demonstrated satisfactory moisturizing activity, which allows one to consider them to be a viable and cost-efficient skin care product that may be used topically. After two weeks of application on dry skin, it was demonstrated that the formulation had the capacity to increase the amount of moisture contained in the skin (from 30% to 60%). Overall, the body cream formulation is potentially produced as commercial cosmetic product in the future.

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Conflicts of Interest
The authors declare no conflict of interest.

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