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The Effectiveness and Durability of Organic Olive Oil, Bengkoang, and Butterfly Pea Flower Soap for Dry Skin

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Abstract: The skin is the outermost part of the body, which is exposed to all types of pollutants from the air, including microbes. Therefore, it requires an effective cleanser to protect it. However, the cleanser must also be able to maintain skin moisture. The selection of ingredients used for soap is olive oil, jicama, and butterfly pea flowers. These ingredients contain oleic acid, vitamin C, and flavonoids, which are effective in moisturizing, antibacterial, and antioxidants. The purpose of this study was to determine the effectiveness of soap for cleaning, protecting, and moisturizing, to determine the durability by examining the soap's pH, and its antibacterial effectiveness. The methodology used was an experimental design with a one-group pretest and posttest design, which was analyzed quantitatively descriptively. Data collection used experiments, questionnaires, and observation sheets. Observations were in the form of measuring moisture levels using a digital skin analyzer. The results of the T test (paired sample t-test) were t = 11.625, while the T table was 2.04 with a Sig = 0.000 < 0.05 (2 tails). Then the calculated T > T table, so H1 was accepted. The conclusion is that there is an effect of using organic soap from olive oil, bengkoang, and butterfly pea flowers, with good durability and a stable pH, while microbiological tests on *Escherichia coli* bacteria were not as good as eco enzyme soap.

Keywords: Bengkoang; Buterfly pea; Olive oil; Organic soap

Introduction

Organic soap is a cleansing cosmetic formed by the saponification of sodium or potassium with fatty acids. The fatty acids in organic soap are obtained from natural ingredients such as olive oil, coconut oil, and castor oil. Fatty acids that bind with sodium salts (NaOH) produce solid soap, while those bound with potassium salts (KOH) produce liquid soap (Iriany et al., 2020; Kim et al., 2015). The raw materials of a soap influence its effectiveness and safety. Safe and high-quality soap is made from natural ingredients and contains minimal or no active ingredients. Therefore, it is suitable for dry and sensitive skin because it moisturizes (Amin et al., 2023; Fluhr et al., 2024). Soap effectiveness can be assessed based on chemical, physical, biological, and environmental factors. Chemical factors are influenced by surfactant content, emollients, and pH levels. Physical factors are influenced by texture, particle size, and foaming ability. Biological factors are influenced by skin type and condition, as well as age. Environmental factors are influenced by temperature, water quality, and air humidity. The soap in this study was made from olive oil, containing oleic acid (omega 9), accounting for 55–83% of the total fatty acid content. This fatty acid has properties that maintain moisture and soften the skin (as an emollient). Other ingredients include antioxidants (polyphenols), vitamins A, E, and F, squalene, and anti-inflammatory properties.

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Another active ingredient is jicama (Pachyrhizus erosus). The jicama tuber is widely used for its starch-containing essence. Other ingredients that also have skin benefits are antioxidants, including vitamin C, flavonoids, and saponins, which can prevent skin damage from free radicals. Jicama tubers also contain phenolic compounds that can inhibit melanin formation (pigmentation) caused by ultraviolet (UV) rays from the sun and can help reduce acne scars and other skin conditions (Piquero-Casals et al., 2023; Damodaran & Nair, 2023). The natural phosphorus and calcium found in jicama are effective in maintaining youthfulness and elasticity of facial skin, and can also make the skin whiter, smoother, and more radiant (Tsai & Chien, 2022; Karkoszka et al., 2024). The next active ingredient is the butterfly pea flower (*Clitoria ternatea* L.). Butterfly pea flowers contain tannins, phobatanin, carbohydrates, saponins, triterpenoids, phenols, flavonoids, flavanol glycosides, proteins, alkaloids, anthraquinones, anthocyanins, stigmasite 4-ene-3,6-dione, volatile oils, and steroids.

The fatty acid composition includes palmitic, stearic, oleic, linoleic, and linolenic acids. Butterfly pea seeds also contain cinnamic acid, phytosterol, and beta-sitosterol (Tanwar et al., 2023; Labdelli et al., 2022; Qian et al., 2020). The flavonoid content in butterfly pea flowers exhibits antioxidant properties by counteracting the formation of free radicals caused by UV radiation in the melanin biosynthesis pathway. Furthermore, flavonoids act as metal chelators on tyrosinase, thereby inactivating tyrosinase activity during melanogenesis (melanin formation) (Namiecińska et al., 2025; Lee et al., 2025; Lee et al., 2016). Therefore, it has the potential to be used as a source of antioxidants to inhibit hyperpigmentation in the skin caused by UV exposure because butterfly pea flowers contain phytochemical compounds that act as antioxidants and have the ability to absorb UV-B and UV-C rays, which play a role in modulating the protective effect against UVR on the skin (Tang et al., 2024; Smith et al., 2023; Lee et al., 2021). Meanwhile, the ethanol extract of butterfly pea flowers can be formulated as a good antiseptic liquid soap preparation because it meets the SNI standards for liquid soap quality requirements. Antiseptic liquid soap with butterfly pea flower ethanol extract is effective as an antibacterial for *Staphylococcus aureus* because it can inhibit more than 10 mm.

Antiseptic liquid soap with butterfly pea flower ethanol extract is effective in inhibiting *Staphylococcus aureus* bacteria in the strong category, namely 12.23 mm at a concentration of 10% and 14.36 mm at a 15% concentration (Putri & Devientasaria, 2023). Therefore, butterfly pea flowers are very suitable as a soap for treating dry skin caused by air pollution. One of the mandatory tests for soap is an antibacterial test or microbiological test. This is because soap contains lipophilic groups that can inhibit and kill bacteria. Its active ingredients, such as butterfly pea flower and eco-enzyme, also have antibacterial properties (Widiani et al., 2024; Kusumawati et al., 2023). Based on the above background, research was carried out with the purpose of determining the effectiveness of soap for cleaning, protection, and moisturizing, as well as determining the durability by examining the soap's pH and its antibacterial effectiveness.

Method

The research method was an experimental study with a quantitative approach, accompanied by descriptions of product durability testing and microbiological tests. This research design observed conditions before and after treatment, but without a control group. This design was used in accordance with the intended objective: to determine the effect of using organic soap made from olive oil, jicama, and butterfly pea flowers on dry skin. The study involved 30 university students with dry skin. The experiment was conducted for two weeks, with treatments twice daily while bathing using organic soap made from olive oil, jicama, and butterfly pea flowers. The following is the soap formulation used in the study.

Table 1. Soap formulation

Ingredients Name	Quantity (gram)
Coconut oil	255
Olive oil	595
NaOH	120
Distilled water	250
Jicama starch	10
Butterfly pea flower	10

The independent variable was the use of organic soap, the dependent variable was the effect of organic soap use, and the control variables were the soap-making process and how the soap was used. The research data were primary data obtained from observations of skin moisture levels before and after soap use, as well as primary data from questionnaires distributed to respondents. Observations were conducted using a digital skin analyzer. The body parts measured were the skin on the backs of the hands, forearms, and elbows. Measurements were taken in the first and second weeks. The measurement results were scored as follows: Score 1: 1–18%, very dry skin condition; Score 2: 19–36%, dry skin condition; Score 3: 37–54%, moderately dry skin condition; Score 4: 55–72%, skin condition not dry.

The questionnaire covered aspects of acceptability and soap usage results. Acceptability was assessed

based on foam production, aroma, and color. The soap usage results assessed in the questionnaire included softness, a moist, and clean sensation. The research hypothesis was the effect of using organic soap made from olive oil, jicama extract, and butterfly pea flowers on the development of skin moisture, acceptability, softness, and a clean sensation. In addition to quantitative methods, a descriptive study was conducted by examining pH levels and microbiological testing. The pH test was conducted using a pH meter, while the microbiological test used the Total Plate Count method to visually count the number of bacterial colonies on nutrient agar media.

Results and Discussion

After the soap was made, researchers conducted a quantitative moisture test on 30 respondents, by measuring the elbows, backs of the hands and arms, then calculating the average of the 3 areas. Measurements were carried out 3 times, before use, 1 week and 2 weeks after use.

Figure 1. Organic soap made from olive oil, bengkoang essence and butterfly pea flowers

Figure 2. Graph of average skin moisture before and after soap use

The graph above shows that the average moisture content in the elbows, backs of hands, and arms increased before use, during the first and second weeks. The average initial moisture content was 30.77, the first week's moisture content was 35.33, and the second week's moisture content was 45.27. This increase in moisture content is due to the soap's natural moisturizing properties, including olive oil. Next, acceptability, softness, and clean sensation were assessed. The questionnaire results are as follows.

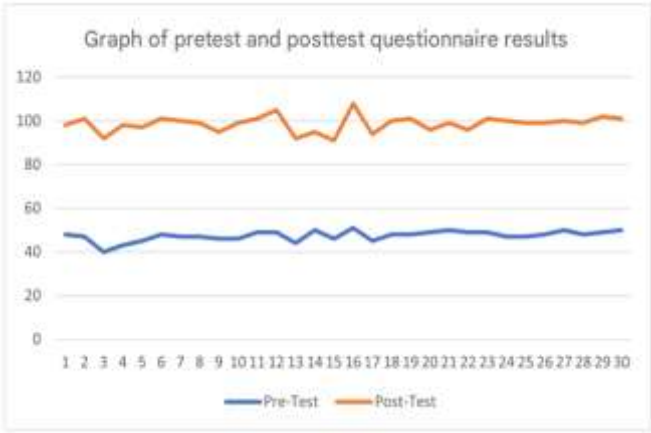

Figure 3. Graph of pretest and posttest questionnaire score results

The hypothesis test used in this study was a parametric statistical test, namely the Paired Sample T-test, because it was derived from two interrelated variables.

Table 2. Paired sample T-test results

Pair 1	Mean	N	Std. Deviation	Std. Error Mean
	Pretest	30.77	30	5.630
	Posttest	45.27	30	8.081

Based on the table about the t test (paired sample t test), it shows $t_{count} > t_{table}$, namely $t_{count} = 11.625$ and $t_{table} = 2.045$ besides there is a significant difference between the results before and after the use of organic soap. Based on the results of the t test analysis (paired sample t-test), the results of Sig. (2 tailed) = 0.000 < 0.05 can be obtained, so Ho is rejected and Ha is accepted. So, there is an effect of using organic soap made from olive oil, jicama, and butterfly pea flowers on dry skin. As a pharmaceutical product, this soap needs to be studied for pH to test the durability of the product, the pH is measured for 1 month.

Table 3. Paired samples test

		Mean	Std. Deviation	Std. Error Mean	Paired Differences 95% Confidence Interval of the Difference Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pretest-Posttest	-14.500	6.832	1.247	-17.051	-11.949	-11.625	29	.000

Table 4. Results of pH test of butterfly pea flower soap

Examination Date	Replication	pH	Average pH
7 Januari 2025	1	10.32	10.31
	2	10.29	
	3	10.32	
14 Januari 2025	1	10.20	10.20
	2	10.17	
	3	10.24	
21 Januari 2025	1	10.10	10.16
	2	10.22	
	3	10.14	
28 Januari 2025	1	10.06	10.05
	2	10.06	
	3	10.03	

Figure 4. 12-hour microbiological test figure 3. 12-hour microbiological test

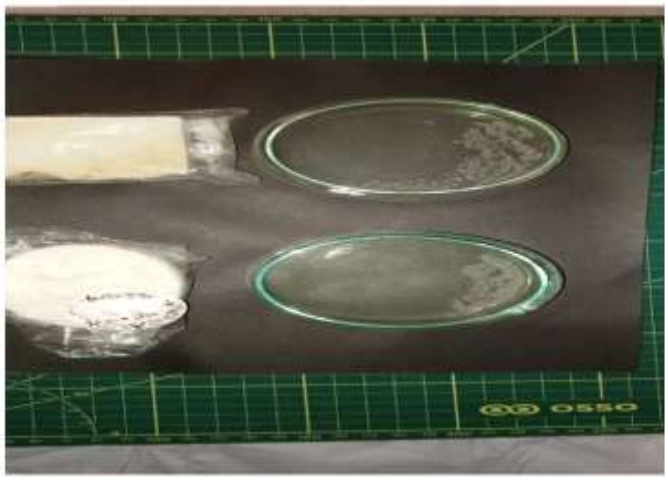

Figure 5. 24-hour microbiology test

Based on pH measurements of the soap over approximately one month, the standard deviation was 0.087. In addition to pH, microbiological tests were conducted on the soap against *Escherichia coli* bacteria. The effectiveness of soaps made from coconut oil, citronella oil, and ecoenzyme was compared. Ecoenzyme itself is made from fermented fruit, vegetable, and sugar residues. The use of coconut oil in ecoenzyme soap not only increases cleaning effectiveness but also provides a pleasant aroma. Furthermore, the antimicrobial properties of coconut oil can increase the product's resistance to microbial contamination. Citronella oil is an essential oil extracted from the leaves of the lemongrass plant. This oil is known for its distinctive lemony aroma and is widely used in various applications, including the food industry, cosmetics, and natural cleaning. It has anti-inflammatory and antimicrobial properties.

Image Caption

Soap 1 (top): soap made from olive oil, jicama extract, and butterfly pea flower; Soap 2 (bottom): soap made from coconut oil, lemongrass oil, and ecoenzyme.

Microbiology Test Results

In the first 12 hours: Number of colonies on soap 1: 58, on soap 2: 0; In the first 24 hours: Number of colonies on soap 1: 104, on soap 2: 16. After obtaining results on moisturizing effectiveness, acceptability, softness, and a clean sensation, the olive oil, jicama, and butterfly pea flower soap demonstrated good results. These results illustrate the appropriate formulation for these aspects. Although this formulation uses caustic soda (NaOH), which produces an alkaline pH of 10, it does not dry out the skin. The moisturizing effectiveness is shown in Figure 1. The soap's moisturizing power comes from olive oil, which contains a high level of oleic acid. This oleic acid also functions as an emollient, a moisturizing agent that softens the skin. Other components of olive oil include vitamins A, D, and E, which function as antioxidants. To determine the shelf life of the soap, a pH test was conducted over approximately one month. The test results showed a standard deviation of 0.087 for the pH after one month of storage. This formulation can be concluded to be sufficiently durable for one month of storage, as there is minimal oxidation during the shelf life (Janssens-Böcker et al., 2025). However, due to its alkaline pH, it is not recommended for use on facial skin

(Lukić et al., 2021; Brooks et al., 2025; Hawkins et al., 2021).

What about microbiological testing? In this study, a soap made from eco-enzyme was used as a comparison. The bacteria tested were *Escherichia coli*. The results indicated that butterfly pea and jicama flower soaps were less effective than eco-enzyme soap. Butterfly pea flowers contain a significant number of compounds, including tannins, phobatanin, carbohydrates, saponins, triterpenoids, phenols, flavonoids, flavanol glycosides, proteins, alkaloids, anthraquinones, anthocyanins, stigmasite 4-ene-3,6 dione, volatile oils, and steroids. They also contain fatty acids such as palmitic, stearic, oleic, linoleic, and linolenic acids. The flower seeds are still usable because they contain cinnamic acid, phytosterol, and beta-sitosterol (Paternina-Ricardo et al., 2025; Li et al., 2022; Allaqaband et al., 2022). The flavonoids in butterfly pea flowers exhibit antioxidant properties by counteracting the formation of free radicals caused by UV radiation in the melanin biosynthesis pathway. Furthermore, flavonoids act as metal chelators on tyrosinase, thereby inactivating tyrosinase activity during melanogenesis (melanin formation) (Sayeed et al., 2016). Furthermore, butterfly pea flowers have the potential to be used as a source of antioxidants to inhibit skin hyperpigmentation caused by UV exposure. They contain phytochemical compounds that act as antioxidants and have the ability to absorb UV-B and UV-C rays, which play a role in modulating the protective effect of UVR on the skin (Cho et al., 2024; Cela et al., 2018; Nghiem et al., 2001).

Flavonoids can also prevent atherosclerosis, a disease that affects the walls of arteries due to the presence of excess fat. Other benefits of flavonoids include anti-allergy, repelling viruses, preventing thrombosis, acting as an antidiarrheal, and boosting the immune system. In addition to flavonoids, butterfly pea flowers also contain anthocyanins, which have benefits for skin beauty. Anthocyanins are natural pigment compounds that give blue or purple hues to butterfly pea flowers and many other berries. Anthocyanins benefit skin beauty by acting as antioxidants, protecting skin cells from damage caused by free radicals and UV exposure. They also help reduce signs of premature aging and maintain healthy skin. Anthocyanins can also help reduce hyperpigmentation or blemishes (Guo et al., 2024; Martín et al., 2017). They help inhibit excessive melanin production, which can cause darkening or blotchy skin. Anthocyanins can also act as anti-inflammatory agents. The anti-inflammatory compounds in anthocyanins can help reduce skin inflammation. This can be beneficial for treating inflammatory skin conditions such as acne or redness.

Another benefit of anthocyanins is that they tighten the skin, as they can help improve skin elasticity and reduce wrinkles, thus promoting healthier skin. Meanwhile, the ethanol extract of butterfly pea flowers (*Clitoria ternatea* L.) can be formulated as a good antiseptic liquid soap preparation because it meets the Indonesian National Standard (SNI) for liquid soap quality requirements. Antiseptic liquid soap with butterfly pea flower ethanol extract (*Clitoria ternatea* L.) is effective as an antibacterial for *Staphylococcus aureus* because it can inhibit more than 10 mm. Antiseptic liquid soap with butterfly pea flower ethanol extract (*Clitoria ternatea* L.) is effective in inhibiting *Staphylococcus aureus* bacteria in the strong category, namely at a concentration of 10% (12.23 mm) and 15% (14.36 mm) (Maulani et al., 2019). Therefore, butterfly pea flowers are very suitable as a soap for treating dry skin caused by air pollution (Hussen et al., 2025; Slominski et al., 2024). In this study, we used *Escherichia coli* bacteria, resulting in less effective results, and the concentration in the formulation was less than optimal. Eco-enzyme is a fermentation product produced from organic materials, such as fruit and vegetable waste, and sugar. According to Lubis et al. (2025), eco-enzyme is a solution containing enzymes, organic acids, and other bioactive compounds produced through a fermentation process.

Eco-enzyme is known as an environmentally friendly alternative to conventional cleaning products. Eco-enzyme soap is known as an environmentally friendly alternative to conventional cleaning products because it is made from natural ingredients and does not contain harmful chemicals. Furthermore, this soap also has additional benefits, such as reducing organic waste and providing positive effects on skin health. Thus, eco-enzyme soap not only functions as a cleanser but also contributes to environmental sustainability (Tallei et al., 2023). Eco-enzyme soap is a cleaning product produced through the fermentation process of organic materials, such as fruit and vegetable waste, and sugar, which contain enzymes, organic acids, and other bioactive compounds. This fermentation process is carried out by microorganisms, such as bacteria and yeast, which convert these materials into a solution with cleaning and antibacterial properties (Solihat et al., 2024; Sawant et al., 2025).

Conclusion

After conducting a number of studies on soap made from olive oil, yam bean extract, and butterfly pea flowers, the following conclusions were obtained: This soap has a good ability to increase the moisture of the skin of the back of the hands, arms, and elbows because of the good effectiveness of olive oil as a natural moisturizer; The pH of the soap is still alkaline, so it is not recommended for use on the face. The average pH results up to storage for approximately 1 month are

10.50; This formulation still shows good stability for approximately one month, based on the standard deviation of storage pH, namely: 0.08; There was an effect of organoleptic tests, softness, and clean sensation from using soap on dry skin; The results of microbiological tests using *Escherichia coli* bacteria were lower than those of soap made from eco-enzyme.

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Author Contributions
Conceptualization, methodology, writing—original draft preparation, writing—review and editing, R.A.M.; validation, formal analysis, F.H.F.; investigation, resources, data curation, I.N. and U.M.R.; visualization, F.H.F. and K.A.T.D. All authors have read and approved the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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