Waste Technology (WasTech)
Journal homepage: http://ejournal.undip.ac.id/index.php/wastech
An International Journal

Liquid Soap Formulation from Virgin Coconut Oil (VCO) With the Addition of Butterfly Pea (*Clitoria ternatea L*) Extract

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Abstract - *In Indonesia, several types of soap have started to spread evenly. One type of soap that is popularly used by Indonesian people is liquid soap. In the manufacture of liquid soap requires the same main raw materials, namely oil/fat and KOH alkaline base. One of the most frequently used oils/fats is virgin coconut oil (VCO). In addition, to increase the usefulness of soap, active ingredients are also needed. Natural/plant active ingredients such as butterfly pea flowers are a solution to reducing the use of chemical active ingredients. This butterfly pea plant has several good ingredients for skin health. Therefore, the manufacture of liquid soap with butterfly pea flower extract was carried out. This study used a factorial design method to determine the optimal liquid soap formulation. With several independent variables used, including KOH concentration, VCO concentration and the length of time of stirring, the results of soap that met SNI were obtained from testing for pH, viscosity, free alkali content, density and water content. The optimal formulation for making butterfly pea flower extract liquid soap is at a concentration of 20% KOH, with a concentration of 50% VCO and a stirring time of 45 minutes.*

Keywords *– Utilization, factorial design, optimization*
Doi: http://dx.doi.org/10.14710/wastech.11.1.52-55
[How to cite this article: Setyaningrum, W., Broto, W. (2023). Liquid Soap Formulation from Virgin Coconut Oil (VCO) With the Addition of Butterfly Pea (*Clitoria ternatea L*) Extract. Waste Technology, 11(1), 52-55 doi: http://dx.doi.org/10.14710/wastech.11.1.52-55]

1. Introduction

Bath soap is one of the primary products used to rid yourself of dirt or microorganisms that are bad for skin health. In Indonesia, soap has 3 types, namely liquid soap, solid soap, and transparent soap, but currently there are more enthusiasts of liquid soap because it is more practical and hygienic (Utari et al., 2016).

In the manufacture of liquid soap, the main ingredients used are oil/fat and KOH alkaline base. The oil/fat used will affect the quality of the soap from its physical or chemical properties (Asri Widyasanti, Anisa Yanthy Rahayu, 2017). Virgin Coconut Oil (VCO) is one of the vegetable oils that can be used as a raw material for making soap which has good cleaning power. The content of this oil is 51% lauric acid, 8.9% caprylic, 7% capric vitamins A, D, E, K which are quite high. It is this lauric acid that has a small molecule that gives it excellent foaming properties, good surfactant properties and is soft for soap (Sukartin and Sitanggang, 2005).

In addition to the base or main ingredient of soap, soap preparations also require active ingredients to increase their use/benefit. Usually the active ingredients of the soap used are chemicals that are quite dangerous when used continuously. Therefore, the use of natural ingredients/ plants is a solution to this problem. Utilization of plants as active ingredients in Indonesia is still less than optimal, one of the plants that is still rarely used is the telang flower plant. In Indonesia, Telang flowers are only used as ornamental plants which eventually the flowers wither and fall, whereas according to (Budiasih, 2017) Telang flowers have the potential as antibacterial because the content is in the form of flavonoids and a fairly large alkaloids. Because of its content, the Telang flower can be used as an active ingredient in soap.

Several studies on the manufacture of soap with butterfly pea extract have begun to develop. In this study (Siti Isnaeni, 2020) researchers formulated liquid body soap with variations of KOH and Na CMC based on olive oil. Then research related to liquid bath soap was also carried out by (Pertiwi et al., 2022), researchers conducted a similar study but with variations in the amount of butterfly pea flower extract for its antibacterial content. Because olive oil is quite expensive, in this study an alternative formulation of liquid body soap was carried out using VCO as a raw material with variations in KOH concentration, VCO concentration, and stirring time. Because olive oil is quite expensive and is still hard to find in Indonesia, in this research an alternative

formulation of liquid body soap was carried out using VCO as a raw material with variations in KOH concentration, VCO concentration, and stirring time. Based on this, the purpose of this study are:

a. Utilization of Telang Flower Plants as Selling Value Products.
b. Perform alternative innovations on liquid soap extracts of Telang Flowers.
c. Finding the Best Formulation of Telang Flower Extract Liquid Soap for Community Development in the Economy.

2. Materials and Methods

In this study the materials used were butterfly pea flowers (from a butterfly pea flower shop in Sleman, Yogyakarta, Indonesia), virgin coconut oil (VCO) and oleum rosae (from Indrasasi Chemical Store, Semarang Indonesia), KOH (Potassium Hydroxide), HEC, glycerin, stearic acid, EDTA, foaming, 70% ethanol and all chemicals from Diponegoro University Vocational School Laboratory. While the equipment used is a rotary evaporator, magnetic stirre, measuring cups, beakers, packaging bottles, reagent spoons, pycnometers, Oswalt viscometers, and porcelain cups and oven.

2.1. Manufacture of butterfly pea extract

The process of making butterfly pea flower extract was carried out according to previous researchers (Pertiwi et al, 2022). Butterfly pea flower extract (Clitoria ternatea L) was obtained by maceration using 70% ethanol solvent. 200 grams of butterfly pea flower powder was weighed then put into a beaker glass to add 70% ethanol with a ratio of 1:4 as much as 800 ml, stir and let stand for 1x24 hours. Store in a dark place to avoid direct sunlight. The macerated butterfly pea flower samples were then filtered using filter paper to produce filtrate and residue and then entered into the evaporation stage using a rotary evaporator.

2.2. Liquid Soap Formulation of Butterfly Pea Flower Extract

The process of making liquid soap is carried out in accordance with previous research (Korompis et al, 2020) by calculating and weighing all the ingredients to be used according to the variables. A variable amount of VCO oil is put into the beaker, then added with potassium hydroxide little by little while continuing to be heated at a temperature of 70˚C -80 ˚C with variable stirring time. Then add the texapon and HEC which has been dissolved with glycerin, stir until homogeneous. Then stearic acid, EDTA, foaming, and butterfly pea flower extract were added, stirred until homogeneous. Liquid soap is added with distilled water to a volume of 200 ml, put in a clean container that has been prepared.

Tabel 1. Liquid Soap Formulation of Butterfly Pea Flower Extract

Material	F1 (-)	F2 (+)	function
Butterfly Pea Flower Extract	5 ml	5 ml	antioxidants
KOH	20%	30%	soap maker
VCO	40 %	60 %	fatty acid
HEC	2 ml	2 ml	Thickeners and emulsifiers
Gliserin	6 ml	6 ml	Thickeners and emulsifiers
Asam Stearat	1 ml	1 ml	foam stabilizer
Oleum rosae	1 ml	1 ml	fragrance
Texapon	1 ml	1 ml	Surfactant
EDTA	1 ml	1 ml	preservative
Aquadest	Ad 200	Ad 200	solvent

This research was conducted using the factorial design method with four research procedures carried out, namely making butterfly pea extract, making butterfly pea extract liquid soap and testing and optimization. Several tests were carried out including pH testing, free alkali content test, water alkaline content test, viscosity test, and density test. Then the factorial design level 23 method was used to optimize the formulation of butterfly pea extract liquid soap with the independent variables used being KOH concentration (20% and 30%), virgin coconut oil (VCO) concentration (40% and 60%) and stirring time (40 minutes and 50 minute).

3. Results and Discussion

3.1. Butterfly pea flower extraction

Making butterfly pea extract using the maceration method yielded fewer results than previous studies (Siti Isnaeni, 2020) because the amount of material used in this study was also less than previous.

Figure 1. Results of Butterfly Pea Flower Ethanol Extract

Table 2. Results of Butterfly Pea Flower Ethanol Extract

dry powder (gr)	Etanol 70% (ml)	liquid extract (ml)	concentrated extract (ml)	residual ethanol (ml)	yield (%)
200	800	640	256	384	0.4

3.2. Liquid soap formulation

Soap making from butterfly pea flower extract is done by hot process method. This aims to maximize the saponification reaction between the oil used, namely VCO, and an alkaline base in the form of KOH. In this study, a factorial design was carried out with level 23, where in this study there were 3 variables, namely the concentration of the amount of VCO (60% and 40%), the concentration of the amount of KOH (25% and 20%), and the length of time of stirring (40 minutes and 30 minute). This research was conducted with 8 experiments with the use of symbols (+) and (-) which are markers for the upper and lower limits of each variable used in each experiment.

Tabel 3. Data on the results of making butterfly pea extract liquid soap

No.	v	k	t	vk	vt	kt	vkt	pH	free alkali content	water content	viscosity	density
1	-	-	-	+	+	+	-	8,90	0,0415	12,3	1174,48	1,002
2	+	-	-	-	-	+	+	8,8	0,0384	10,65	1062,97	1,001
3	-	+	-	-	+	-	+	9,6	0,0812	12,8	1311,32	1,004
4	+	+	-	+	-	-	-	9,7	0,084	13,1	1298,02	1,002
5	-	-	+	+	-	-	+	8,9	0,0425	12,65	1185,6	1
6	+	-	+	-	+	-	-	9,2	0,0546	11,3	1211	1,001
7	-	+	+	-	-	+	-	9,7	0,086	13,05	1361,62	1,008
8	+	+	+	+	+	+	+	9,8	0,0917	13,4	1360,86	1,008

In the 8 experiments that were carried out, it can be seen in Table 3 that the pH of the soap has a value corresponding to the level sign of the KOH concentration process variable where at a large (+) KOH concentration it has a large pH value as well. Therefore, to find out the most influential process variables in this study, the quicker method was used, namely calculating the main effect and the interaction with the resulting pH value.

Table 4. Main Effect and Interaction Calculation results for pH

Effect	Amount
I_1, v	0,1
I_2, k	0,75
I_3, t	0,15
I_{12}, vk	4,44E-16
I_{13}, vt	0,1
I_{23}, kt	-0,050
I_{123}, vkt	-0,1

Table 5. Presentation of Influential Variables

P (%)	Effect
7,143	-0,1
21,429	-0,05
35,714	4,44 E-16
50,000	0,1
64,286	0,15
78,571	0,15
92,857	0,75

Table 5 shows that the greatest effect value is at 0.75 which shows that the most influential variable is the amount of KOH concentration.

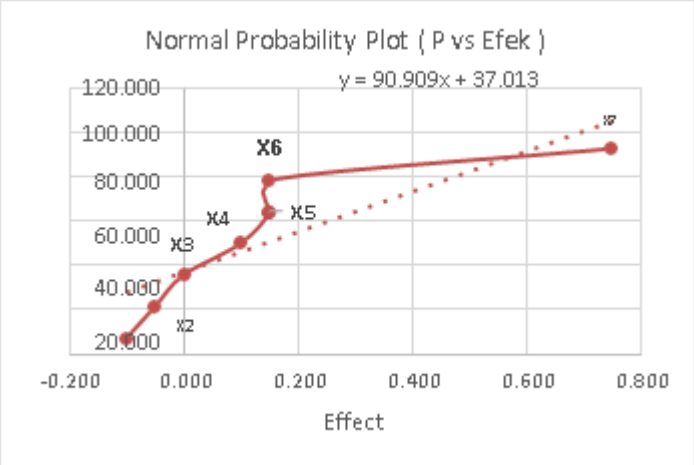

Figure 2. Normal Probability Plot (P vs Effect)

From the results of this analysis, we can optimize the process by varying the number of KOH concentration variables (k) to determine the pH value and test the best results compared to SNI (Indonesian National Standard) for liquid soap.

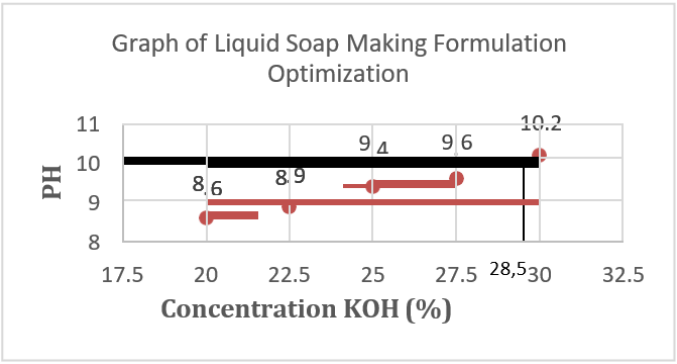

Figure 3. Graph of Liquid Soap Making Formulation Optimization

Based on the resulting pH value, it can be seen that the greater the concentration of KOH, the greater the pH value. The formulation of 30% KOH concentration with 50% virgin coconut oil concentration and 45 minutes of stirring time obtained the highest pH value. This is because KOH is a strong basic compound so that when it is in water, KOH will completely ionize to produce OH- ions and will significantly affect the pH value in the manufacture of butterfly pea extract liquid soap. The results of this study are in accordance with previous research (Silsia et al., 2017). According to Wijana, et al (2010) pH is the most important indicator in soap because the pH value determines the feasibility and packaging of the liquid soap to be used. SNI 4085- 2017 requires the pH of liquid soap to be between 4 –

10 so that at a pH value of 10 with a KOH concentration of 28.5% the reaction is stopped. Then for the best pH value found in the formulation of 20% KOH concentration, 50% VCO concentration and 45 minutes of stirring time with the lowest pH value.

Table 6. Test results of Butterfly Pea Flower Extract Liquid Soap

Testing	Butterfly pea flower extract liquid soap	SNI Value (SNI 4085: 1996)
Viskositas (cPs)	1174,48	400-4000 cPs
Kadar Alkali Bebas (%)	0,0320	Maks 0,1 %
Kadar Air (%)	12,3	<15 %
Densitas	1,001	1,001 – 1,1

Based on the comparison of the results of testing the butterfly pea flower extract liquid soap with SNI soap, it was found that the results were in accordance with the SNI so that the butterfly pea flower extract liquid soap formulation was safe to use and had optimal results.

4. Conclusion

Based on this research, it was found that the optimal formulation for making butterfly pea flower extract liquid soap was with a concentration of 20% KOH, with a concentration of 50% virgin coconut oil and a long stirring time of 45 minutes. In several tests, the results were in accordance with SNI. The obtained pH value was 8.6, the viscosity was 1124.48, the free alkyl content was 0.0320%, the water content was 12.3% and the density obtained was 1.001. Because the butterfly pea flower extract liquid soap meets the standards, the butterfly pea extract liquid soap can be applied in daily life and developed by the community to improve the economy.

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