Journal of Vocational Studies on Applied Research

Formulation of Antibacterial Liquid Soap Based on Virgin Coconut Oil with Various Concentrations of Carica Concentrate and Potassium Hydroxide Volume

Siti Dianti[*] and Heny Kusumayanti

Industrial Chemical Engineering, Vocational School, Diponegoro University
Jalan Prof. Soedarto, SH, Tembalang, Semarang, Central Java 50275

[*)] Corresponding author: sity.dianty@gmail.com

Abstract *– Carica is one of the main commodities in Dieng, Central Java. It contains vitamin A, vitamin C, and antibacterial substances such as flavonoid, polifenol, and tannin. Due to its content, carica can be used as an additive for soap products. Soap is one of the cosmetic products, produced from the saponification reaction between alkali and fatty acids. Carica liquid soap was carried out by reacting KOH with virgin coconut oil that contains fatty acids, then adding carica fruit juice and other ingredients. The product of liquid soap will be analyzed including pH, density, free fatty acids content, organoleptic test, and antibacterial activity. The research method used is a factorial design. Research has shown that the carica liquid soap were in accordance with SNI 06-4075-1996 and SNI 06-3532-1994. The best quality of carica liquid soap obtained at pH 11, density 1,0266, and free fatty acid content of 0,082%. Antibacterial activity was carried out using the paper disk method, showing that the antibacterial activity of the soap has a weak performances with an inhibition zone of 1,25 mm. The organoleptic test showed that panelist's preference for carica liquid soap was low.*

Keywords*: carica; factorial design; liquid soap; saponification*
Received: April 25, 2022 Revised: June 17, 2022 Accepted: July 12, 2022

Doi: http://dx.doi.org/10.14710/jvsar.v4i1.14140
[How to cite this article: Dianti, S., and Kusumayanti, H. (2022). Formulation of Antibacterial Liquid Soap Based on Virgin Coconut Oil with Various Concentrations of Carica Concentrate and Potassium Hydroxide Volume. *Journal of Vocational Studies on Applied Research, 3*(3), 68-72. doi: http://dx.doi.org/10.14710/jvsar.v4i1.14140]

INTRODUCTION

The Dieng Plateau is the only area in Indonesia where carica is grown. Located at an altitude of 1400-2400 meters above sea level, making the Dieng Plateau a suitable place for cultivating carica plants (Laily et al., 2012). Carica has a myriad of potentials and benefits, unfortunately the majority of Dieng people only use Carica as food products. Meanwhile, the productivity of carica is decreasing, not proportional to the availability of land for carica cultivation (Badan Pusat Statistik Wonosobo, 2019). One of the causes of decreased productivity of carica fruit is the lack of diversification of carica products.

Carica (*Carica pubescens*) is a typical fruit that is only able to grow at low temperatures ranging from 12-18°C, and in areas with high rainfall intensity. Carica has a small fruit, round in shape with a thick yellow skin. Carica has a distinctive fragrant aroma, and the inside of the fruit is hollow and filled with seeds wrapped in *sarkotetsa*. Carica contains vitamin C of 65.12 mg/100 g and vitamin A of 1771.1 g/100 mg. Apart from containing vitamins, phytochemicals are also found in carica fruit. After the phytochemical screening test, it was found that carica contains secondary metabolites, namely flavonoids, alkaloids, polyphenols, tannins, and saponins. These secondary metabolites can act as antibacterial

substances (Laily et al., 2012). Based on its content, carica fruit can be used as an additional ingredient in making liquid soap.

Soap is a cosmetic products made by saponification reaction of fatty acids and alkali with the help of heat ranging from 60-80°C. Soap is a group of surfactants that can reduce surface tension so that it plays a role in the dirt cleaning process (Friedman & Wolf, 1996). In general, soap can be found in solid and liquid forms. However, liquid soap is considered superior because it tends to be more stable. The fatty acids used in soap can be obtained from oil. The oil commonly used for soap making is virgin coconut oil. Virgin coconut oil contains 47-50% of fatty acid, namely lauric acid (Nasir et al., 2017). Lauric acid has natural antibacterial ability against *Staphylococcus aureus, Staphylococcus epidermis, and Propinobacterium acnes* (Widiyarti et al., 2009).

In this study, soap making was based on the saponification reaction between KOH and virgin coconut oil that contains fatty acids, with a saponification temperature of 70°C. The purpose of this study was to formulate carica liquid soap and to determine the effect of adding carica fruit juice and KOH volume to the resulting soap.

METHODOLOGY

Materials and Tools

The tools used in this research are glass beaker, analytical scale, magnetic stirrer, thermometer, burette, stative, spoon, picnometer, oven, electrical stove, spoon, glass rod, erlenmeyer, pH indicator, and viscometer. Materials used in this research are carica, KOH, virgin coconut oil, aquadest, honey, ethanol 96 %, cocamide diethanolamine, stearic acid, and PP indicator.

Method

Preliminary treatment

Preparation of raw materials for carica fruit was carried out by washing the fruit in running water. Peel the carica fruit skin and remove the seeds. Cut the carica fruit then soak it in the whiting solution for 10 minutes to remove the sap.

Making of carica concentrate

The making of carica concentrate can be seen at Fig 1

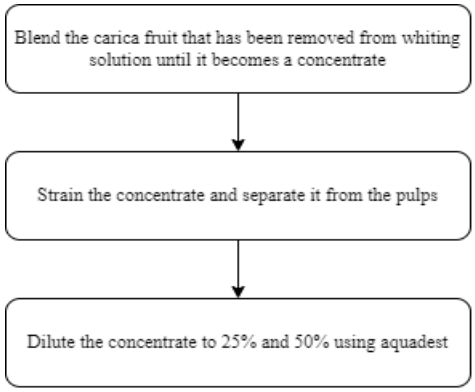

Figure 1 Carica concentrate making process

Saponification process

The process of making liquid soap refers to preliminary research conducted by Widyasanti et al., (2019). Melt the stearic acid in a beaker glass using magnetic stirrer. Add 60 grams of virgin coconut oil, and KOH according to the variable. Mix it for 60 minutes at 70°C with a stirring speed according to variable. According to Widyasanti et al., (2019), the amount of aquadest used to dilute soap paste is 134,29, in this research, we add 129,79 grams of aquadest into the paste. After the paste formed, dilute it by adding 129,79 grams of aquadest. Add other ingredients such as 5,46 grams of cocamide diethanolamine, 7,5% honey, and carica concentrate. Lower the temperature to 40°C, and let the liquid soap set for 24 hours.

pH test

Dip the pH strip in liquid soap, and wait until the colour of pH strip changed. Determine the pH using indicator scale.

Density test

Weigh the empty pycnometer, then fill the pycnometer with liquid soap. Weigh again the pycnometer. Calculate with formula:

$$\rho = \frac{pycnometer\ with\ soap - empty\ pycnometer}{pycnometer\ volume} \quad (1)$$

Free fatty acids test

Neutralize 96% ethanol using KOH. Weigh 5 grams of liquid soap, put it into neutral ethanol, heat it. Add 3 drops of PP indicator. Run a titration method using 0.1N KOH until a constant pink color appears. Calculate with formula:

$$\text{Free fatty acids} = \frac{V\ x\ N\ x\ BM}{W} \text{ x } 100\% \quad (2)$$

Antibacterial activity test

Antibacterial activity testing was carried out using the paper disk method. The bacteria used was *Staphylococcus aureus*.

RESULTS AND DISCUSSION

pH

The results of pH can be seen at Table 1 below

Table 1 Results of pH

Variabel	Concentrations of carica concentrate (%)	KOH volume (mL)	pH
1	25%	28	10
2	50%	28	9
3	25%	32	11
4	50%	32	12
5	25%	28	10
6	50%	28	9
7	25%	32	11
8	50%	32	11

The pH results of carica liquid soap are in the range of 9-12. Based on SNI 06-4085-1996 the safe pH range to use is 8-11 (Badan Standardisasi Nasional, 1996). So that the results of carica liquid soap are still safe to use and harmless to the skin. The highest pH is 12 this could be due to the presence of excess KOH.

Based on Figure 2 which shows a graph of the normal probability between the P value and the effect for the pH variable. The regression value is 84.37%, which means that 84.37% of the total variation of the bias model can be represented by the regression equation. After calculating using quicker method, it can be concluded that the volume of KOH is the most influential variable on pH.

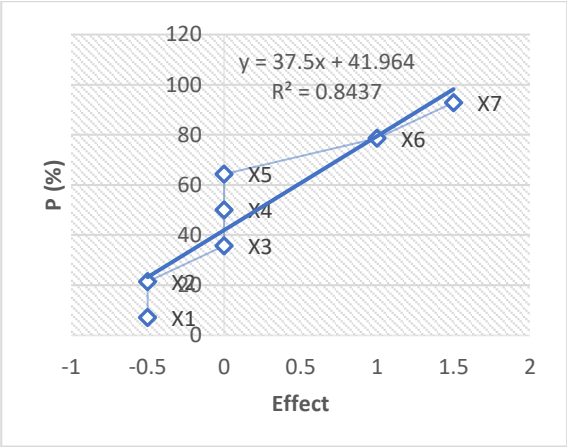

Figure 2 Graph of normal probability between P value and effect for pH

Density

The results of density can be seen at Table 2 below

Table 2 Results of density

Variable	Concentrations of carica concentrate (%)	KOH volume (mL)	Density
1	25%	28	1,0212
2	50%	28	1,03
3	25%	32	1,0208
4	50%	32	1,0704
5	25%	28	1,0476
6	50%	28	1,0244
7	25%	32	1,0196
8	50%	32	1,0266

Based on SNI 06-4085-1996, the density range of liquid soap is 1.01-1.10 (Badan Standardisasi Nasional, 1996). In the results of the study, the density of the carica liquid soap was in the range of 1.0196-1.0704. So it can be concluded that the density is in accordance with SNI 06-4085-1996.

Free Fatty Acids

The results of free fatty acids can be seen at Table 3 below

Table 3 Results of free fatty acids

Variable	Concentrations of carica concentrate (%)	KOH volume (mL)	FFA(%)
1	25%	28	0,123
2	50%	28	0,205
3	25%	32	0,082
4	50%	32	0,328
5	25%	28	0,053
6	50%	28	0,164
7	25%	32	0,082
8	50%	32	0,082

Determination of free fatty acids is using titration method. Based on SNI 06-3532-1994, the maximum free fatty acid content contained in liquid soap is 2.5% (Badan Standardisasi Nasional, 1994). Thus, the free fatty acid levels of all research variables were in accordance with SNI 06-3532-1994 in the range of 0,053%-0,328%. Free fatty acids is one of the important parameters that determine abrasiveness of soap (Vivian et al., 2014). If the soap has high free fatty acids, it will cause a rancid odor, harsh to skin, and has low cleaning power.

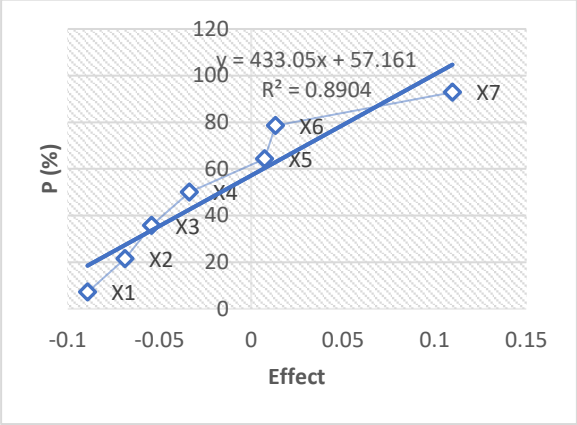

Figure 3 Graph of normal probability between P value and effect for free fatty acids

Based on Figure 3 which shows a graph of the normal probability between the P value and the effect for the free fatty acids variable. The regression value is 89.04%, which means that 89.04% of the total variation of the bias model can be represented by the regression equation. After calculating using quicker method, it can be concluded that the addition of carica concentrate is the most influential variable on free fatty acids.

Organoleptic Test

The results of organoleptic test can be seen at Table 4 below

Table 4 Results of organoleptic test

Run	Carica (%)	KOH (mL)	Texture	Colour	Odor
1	25%	28	5	2	4
2	50%	28	4	2	4
3	25%	32	4	2	4
4	50%	32	3	2	4
5	25%	28	5	2	4
6	50%	28	4	2	4
7	25%	32	3	2	4
8	50%	32	3	2	4

Organoleptic test was carried out with 20 panelists, and the average level of preference of the panelists was obtained. Scores of 1= liked very much, 2=liked, 3=neutral, 4= slightly disliked, 5= disliked. The panelists' preference level was highest in samples 4, 7, and 8. The color of the soap produced was yellow. All panelists stated that they had a low level of preference for the odor produced by Carica liquid soap. This is because there is no added fragrance in the natural soap making process

Antibacterial Activity

The result of antibacterial activity can be seen at Fig 4 below

Figure 4 Antibacterial activity using paper disk method

Antibacterial activity was carried out using the paper disk method. The sample tested is the 8th variable sample. Antibacterial activity was indicated by the presence of an inhibition zone. In Figure 2, an inhibition zone of 1.25 mm is formed. According to Davis & Stout, (1971), if the inhibition zone formed was less than 5 mm, the antibacterial performance still categorized as weak. It is necessary to add other additives that have antibacterial properties to strengthen the antibacterial ability of carica liquid soap.

CONCLUSION

Research shown that the results of pH, density, and free fatty acids were in accordance with SNI 06-3532-1994 and SNI 06-4085-1996. The best quality of liquid soap obtained at 8th variable with addition 50% carica concentrate, 32 mL KOH, and 400 rpm stirring speed. The results from 8th variable for pH is 11, density is 1,0266, and it contains 0,082% free fatty acids. Carica liquid soap has a weak antibacterial ability. Based on factorial design using quicker method, it was found that the most influential variable for pH is volume of KOH, and the most influential variable for free fatty acids is addition of carica concentrate, volume of KOH, and stirring speed.

NOTATION

Density	ρ
Molecular weight of fatty acids	BM
Normality of KOH/HCl	N
Volume of KOH/HCl	V
Weight of liquid soap	w

ACKNOWLEDGMENT

The authors would like to thank the Industrial Chemical Engineering Department of Vocational School in Diponegoro University for the facilities that have been provided in carrying out this applied research.

REFERENCES

Badan Pusat Statistik Wonosobo. (2019). *Wonosobo*

dalam Angka. wonosobokab.bps.go.id

Badan Standardisasi Nasional. (1994). *SNI Sabun Mandi*.

Badan Standardisasi Nasional. (1996). *SNI Sabun Cair*.

Davis, & Stout. (1971). Disc Plate Method of Microbiological Antibiotic Assay. *Applied Microbiology*.

Friedman, M., & Wolf, R. (1996). *Chemistry of Soaps and Detergents: Various Types of Commercial Products and Their Ingredients*.

Laily, A. N., Suranto, & Sugiyanto. (2012). Characterization of Carica pubescens in Dieng Plateau, Central Java based on morphological characters, antioxidant capacity, and protein banding pattern. *Nusantara Bioscience*.

Nasir, N. A. M. M., Abllah, Z., Jalaludin, A. A., & Shahdan, I. A. (2017). Virgin Coconut Oil and Its Antimicrobial Properties against Pathogenic Microorganisms: A Review. *Advances in Health Science Research*.

Vivian, O. P., Nathan, O., Osano, A., Mesopirr, L., & Omwoyo, W. N. (2014). Assessment of the Physicochemical Properties of Selected Commercial Soaps Manufactured and Sold in Kenya. *Open Journal of Applied Science*.

Widiyarti, G., Hanafi, M., & Soewarso, W. P. (2009). Study on the Synthesis of Monolaurin as Antibacterial Agent Againts *Staphylococcus aureus*. *Indo. J. Chem*.