J. Pijar MIPA, Vol. 17 No.4, July 2022: 533-537 ISSN 1907-1744 (Print)
DOI: 10.29303/jpm.v17i4.3703 ISSN 2460-1500 (Online)

THE EFFECT OF SUCROSE CONCENTRATION ON THE TRANSPARENCY OF SOLID SOAP-BASED COOKING OIL

Irda Handriani, Ika Kusuma Nugraheni*, and Mariatul Kiptiah
Agricultural Industrial Technology Department, Politeknik Negeri Tanah Laut, South Kalimantan, Indonesia
*Email: ika.kusuma.n@politala.ac.id

Received: June 22, 2022. Accepted: July 16, 2022. Published: July 31, 2022

Abstract: This research aimed to identify the effect of sucrose concentration on the transparency of solid soap and to analyze the quality of used cooking oil based on the pH standards of bath soap and the quality requirements of bath soap. Sucrose, a soaping agent, was concentrated at 0%, 7%, 9%, 11%, and 13%, for the test was carried out three times in a row. The test of solid soap was a test of soap transparency, pH, air content, amount of fatty acids, free alkali, free fatty acids, neutral fats, and mineral oil. The results showed that the concentration of sucrose in soap making greatly affected the transparency of soap. The most transparent is a soap with a concentration of 13% sucrose. The quality of soap based on used cooking oil against the pH standard of bath soap has met the standard, and the quality requirements of the Indonesian Nasional Standard for bath soap are appropriate except for the water content and the number of fatty acids.

Keywords: *Cooking Oil, Sucrose, Bath Soap, Transparency*

INTRODUCTION

The high number in population is in line with the waste number in house activities. One of the households trashes cooking oil. Cooking oil that has passed the period of use or can no longer be used is called waste cooking oil (WCO). WCO, if still used in cooking activities, can cause health problems because of the high amount of saturated fatty acids [1].

Since used cooking oil is no longer consumed, it is necessary to process non-food products from used cooking oil, such as manufacturing solid soap products [2-4]. Soap can be produced by alkaline hydrolysis of waste oil [5-6]. Sodium hydroxide (NaOH) is one of the alkaline used to convert fat into soap in saponification [7]. Soap is one of the body cleansers used by the community and functions to help clean dirt on the skin, including sweat and cosmetic residue [8-9].

The composition of WCO is free fatty acids (FFA), moisture, minerals, a lower amount of hydrocarbons, and impurities [10]. These impurities can make troublesome in the product of WCO. One of the disadvantages of using waste oil in soap making is that the resulting color is unclear.

One solid soap innovation that makes it more enticing is making it transparent. Soap transparency is influenced by several factors, such as alcohol and glycerin. The most critical role in the formation of transparency is sugar (sucrose). Sucrose functions as a transparency-forming agent to increase the aesthetic value of soap [11]. It also acts as a humectant to maintain skin moisture [12].

From the description above, this study presents the reference for making formulations of different concentrations of sucrose in the manufacture of solid soap from used cooking oil which aims to identify the effect of using sucrose in different concentrations to obtain a good level of transparency, as well as to determine the quality of solid soap produced from oil.

RESEARCH METHOD

Equipment and Material

This research used analytical balance, beaker, petri dish, thermometer, hot plate, stir bar, soap mold, and spatula to make bar soap. It used an apparatus for the free fatty acids (FFA) test. The material for making bar soap uses WCO from household activities. It combines with NaOH, alcohol, sucrose, glycerin, aquadest, NaCl, citric acid, propylene glycol, stearic acids, foam booster, and triethylamine (TEA).

WCO Pretreatment

Put 100 grams of WCO into a 1000 ml beaker, and separate it from the waste using Whatman filter paper. After cleaning the impurities, WCO is prepared to be neutralized using NaOH solution. NaOH solution was made with a concentration of 15% (15 grams of NaOH dissolved in 100 ml of distilled water). After that, the filtered WCO was heated at a temperature of ± 40°C, and a 15% NaOH solution was added with the ratio of used cooking oil: NaOH = 100 grams of used cooking oil: 5 mL of NaOH. The mixture was stirred using a stirrer for 10 minutes. After 10 minutes, WCO was filtered by Whatman filter paper to separate the residue from the impurities.

WCO, which had neutralized, continued to bleach by using active charcoal. WCO is heated to 70°C. 10% activated charcoal (500 Mesh) was put into WCO until making a solution. The solution was stirred for 60 minutes and then heated at 150°C. The solution is filtered using Whatman filter paper to separate the impurities so that the purified used cooking oil can be used in soap making [13].

Soap Processing

Transparent soap was made by heating stearic acid and 10 grams of purified used cooking oil until the stearic acid dissolves in the oil at 70℃. It continued by adding the dissolved NaOH (2 grams NaOH in 5 grams aquadest) while constantly stirring because the oil would form a stock of soap. Then propylene glycol is added while stirring until it melts again. After melting, alcohol, glycerin, foam booster, TEA, sugar solution (sugar and 5 grams of aquadest), NaCl, and citric acid were added while stirring until a homogeneous mixture. After that, the solution is poured into the mold and let stand until the soap hardens [14]. The formulation of the composition used in processing solid soap from WCO is seen in table 1.

Table 1. Formulation of solid soap material from WCO

No	Material	F0 (g) 0%	F1 (g) 7%	F2 (g) 9%	F3 (g) 11%	F4 (g) 13%
1	WCO	10	10	10	10	10
2	NaOH	2	2	2	2	2
3	Alcohol	1.5	1.5	1.5	1.5	1,5
4	Sucrose	0	7	9	11	13
5	Glycerin	1.3	1.3	1.3	1.3	1,3
6	Aquadest	10	10	10	10	10
7	NaCl	0.04	0.04	0.04	0.04	0,04
8	Citric Acids	0.04	0.04	0.04	0.04	0,04
9	Propylene glycol	13	13	13	13	13
10	Stearic Acids	4	4	4	4	4
11	Foam booster	0.4	0.4	0.4	0.4	0,4
12	TEA	11	11	11	11	11
13	Parfume	1	1	1	1	1

Soap Transparency Test

This test was carried out by placing soap that had 1 cm in thickness on a paper that had been written on Times New Roman in size 14, then observing the clarity of the writing that penetrates the soap.

pH Analysis

The soap was weighed in 1 gram and dissolved with 10 ml of distilled water. The pH meter is immersed in the solution. The degree of acidity obtained was observed, then the results were recorded.

Quality Analysis of Soap

Soap quality was analyzed based on Indonesian National Standard (SNI) 06-3531-1994. The parameter observed included water content, acid number, free fatty acids number/Alkali (count as KOH), Unsaponifiable fat/ Neutral fat, and mineral oil. All of the methods refer to SNI 06-3531-1994.

RESULT AND DISCUSSION

The results obtained, which were carried out with three repetitions, are as in Figure 1.

(a) (b) (c) (d) (e)

Figure 1. (a). Soap with formulation 0 % (b) Formulation 7 % (c) Formulation 9 % (d) Formulation 11% and (e) Formulation 13%

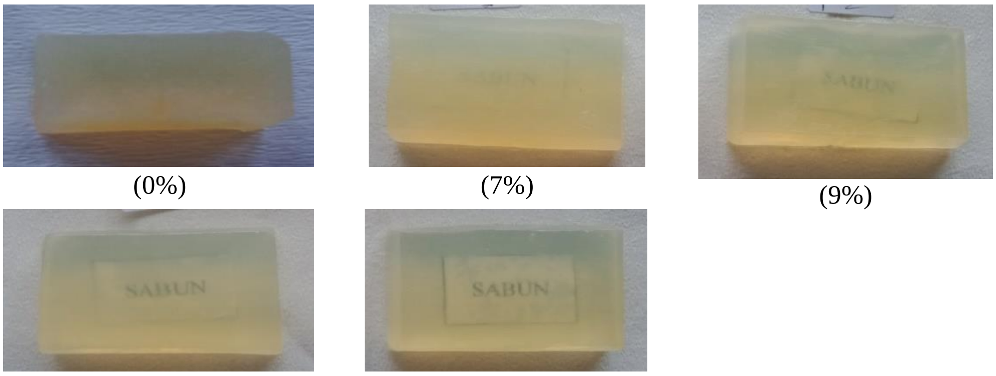
Transparency Result

The results of testing the effect of sucrose concentration on soap transparency can be seen in Figure 2.

Based on the tests, it was found that the concentration of sucrose significantly affects the transparency of the soap. The soap with the most sugar concentration has the most transparent level of transparency. From these results, the soap with formula 4 was the most transparent, where the sucrose concentration was 13%. It is based on the legibility of letters and writing from behind transparent soap preparations. The higher the concentration of sucrose used in soap making, the

J. Pijar MIPA, Vol. 17 No.4, July 2022: 533-537
DOI: 10.29303/jpm.v17i4.3703 ISSN 1907-1744 (Print)
ISSN 2460-1500 (Online)

more transparent the soap produced [15]. Sucrose has a role in helping the development of crystals in soap so that the soap looks transparent and translucent—the whiter of sucrose color used in making transparent soap preparations, the finer the soap produced.



(0%) (7%) (9%)
(11%) (13%)
Figure 2. Transparency test of the soap

pH of soap

The results of the soap pH testing carried out with three repetitions can be seen in Table 2.

In this study, the pH of the bath soap increased when sucrose was added to the oil. It is because sucrose is an alkaline solution that can increase pH[14]. The higher the sucrose solution, the more hydroxyl ions, so it will decrease the H+ ions in the soap. It causes the pH of the soap to increase (alkaline) along with the increase in sucrose.

Inappropriate soap pH values can affect the pH of the skin. It is because the alkaline substances in the soap can neutralize or even damage (if the pH of the soap is very alkaline) the acid coat on the skin, which acts as a barrier to bacteria and viruses and causes dry skin due to loss of water thereby allowing the potential for irritation and allergies.

Solid bath soap for the true soap type made from fat and alkali through a cold process must have a pH between 9-10. It is because bath soap produced using the cold process method will not be able to reach a normal pH. If the pH of the soap is lowered to 7, the soap will separate back into oil and alkaline water. Bath soaps with a pH of 9-10 are a breeding ground for bacteria and microbes, so there is no need to add antibacterial agents to the soap. Meanwhile, soap with a normal pH is highly favored by bacteria and microbes, so the soap needs to be equipped with antibacterial substances [16]. In addition, the alkaline nature of soap can increase the ability of soap to produce a saponification reaction with fat [17].

Table 2. The result of pH testing on soap

Sample	F0 (g) 0%	F1 (g) 7%	F2 (g) 9%	F3 (g) 11%	F4 (g) 13%	pH of Bath Soap (Standard)
Average	10,44	10,55	10,55	10,56	10,58	9-11

Indonesia Standard Test of Soap (SNI 06-3532-1994)

The results of the soap testing refer to the SNI quality requirements for bath soap which were carried out with three repetitions and can be seen in table 3. The results of the water content testing that has been carried out show that none of the formulations conforms to the SNI standard. It can be caused because the distilled water added to the soap in the manufacturing process can affect the water content of the preparation [15]. The saponification process's by-product also affects the preparation's water content. The concentration of NaOH used can affect the saponification process, so the saponification process may not be perfect due to the lack of alkali. Hence, the saponification process's side effects also affect the preparation's water content.

Soap with a high-water content will shrink faster when used. Meanwhile, soap that contains less water can increase its shelf life. However, the duration of soap storage can affect the hardness of the soap because the water content in the soap is getting more and more volatile [18].

The effect of sucrose concentration shows that the higher the sucrose concentration, the higher the water content produced. It is due to the ability of sucrose to bind water. It is because the higher the concentration of sucrose used, the more water bound by sugar and the more water in the soap [14].

Table 3. Test results on the quality requirements of SNI bath soap

Parameters	0%	7%	9%	11%	13%	SNI
Water Content	33	36	36	37	39	Max 15%
Fatty Acid Number	29	27	24	25	26	>70
Free Alkali (count as KOH)	0.8	0.8	0.7	0.8	0.7	Max 0,14%
Neutral fat	2.2	2.2	2.2	2.2	2.2	< 2.5%
Mineral Oil	Negative	Negative	Negative	Negative	Negative	Negative

SNI requires a minimum amount of 70% fatty acids. The results of the tests that have been carried out show that the fatty acid levels obtained do not meet the SNI standards on bath soap. In a formulation, fatty acids act as a regulator of consistency. Fatty acids are obtained naturally through the hydrolysis of triglycerides. Fatty acids have a limited ability to dissolve in water. It will make the soap last longer in conditions after the soap is used. The number of fatty acids that do not meet the SNI standard could be due to the influence of a large enough concentration of NaOH on the saponification.

The addition of sucrose in soap can reduce the fatty acid content. NaOH makes a neutralization process between fatty acids and bases (saponification number) that occurs in the formation of soap stocks [14]. Based on observations, the higher the concentration of sucrose used, the lower the number of saponification produced. Sucrose binds water, causing a reduction in the amount of water available to dissolve the base. It causes the dissolution of the NaOH base in soap preparations to be less than optimal.

Soap results from a saponification reaction between fatty acids in oils/fats with alkalis/bases. A good soap is a soap that is produced from a perfect reaction between fatty acids and alkalis, and it is hoped that there will be no residue after the reaction. However, the expected reaction is not always perfect. For this reason, it is necessary to test the alkali levels after the action. According to SNI (1994), free alkali is calculated as KOH in bath soap at a maximum of 0.14%, while in the tested soap, the free alkali is less than 0.14%. The results of this test indicate that the value of free alkali calculated as KOH already meets the SNI standard on bath soap. Alkalis are harsh and irritate the skin. Excess-free alkali in soap can be caused by a high alkali concentration or excess in the saponification process.

The effect of sucrose on the soap in this study was not very influential. However, sucrose was water-binding, causing a reduction in the amount of water available for dissolving bases. It causes the dissolution of the NaOH base in soap preparations to be less than optimal. If the number of saponification is not perfect, it can cause the percentage of free alkali to increase.

Free fatty acids are fatty acids that are present in solid soap but which are not bound as sodium compounds or triglyceride compounds (mineral fats). The requirement for neutral fat based on SNI (1994) is less than 2.5%. While the test results for neutral fat in all soap formulations are less than 2.5%, so the soap meets the standard. The high free fatty acids in soap will reduce the cleaning power of soap because free fatty acids are unwanted components in the cleaning process. When used, soap will attract the free fatty acid components still in the soap, indirectly reducing its ability to clean oil from oily materials.

SNI requires that the mineral oil content be harmful, and after testing the solid soap from used cooking oil, the results are that all solid soaps tested negative contain mineral oil or do not contain mineral oil. So that all the tested soaps do not contain mineral oil so that they meet the SNI requirements for mineral oil soap. The presence of mineral oil in soap is not expected because it will affect the emulsifying soap with water [19]. If the soap contains mineral oil, the emulsion power of the soap will decrease. In this study, sucrose did not affect neutral fats and mineral oils.

CONCLUSION

The concentration of sucrose in soap making is very influential on the transparency of soap. The soap with the highest concentration of sucrose became the most transparent soap. The quality of soap based on used cooking oil meet the pH standard of bath soap, and the quality requirements of SNI for bath soap are appropriate, except for the water content and the number of fatty acids.

REFERENCES

[1] Soegiantoro, G. H., Chang, J., Rahmawati, P., Christiani, M. F., & Mufrodi, Z. (2019). Home-made eco green biodiesel from chicken fat (CIAT) and waste cooking oil (PAIL). *Energy Procedia*, *158*, 1105-1109.

[2] Li, W., Guan, R., Yuan, X., Wang, H., Zheng, S., Liu, L., & Chen, X. (2020, June). Product Soap from Waste Cooking Oil.

In *IOP Conference Series: Earth and Environmental Science* (Vol. 510, No. 4, p. 042038). IOP Publishing.

[3] Mustakim, M., Taufik, R., & Trismawati, T. (2020). The utilization of waste cooking oil as a material of soap. *Journal Of Development Research*, *4*(2), 86-91.

[4] Sanaguano-Salguero, H., Tigre-Leon, A., & Bayas-Morejon, I. F. (2018). Use of waste cooking oil in the manufacture of soaps. *Int. J. Ecol. Dev*, *33*, 19-27.

[5] Zhu, X. N., Lyu, X. J., Wang, Q., Qiu, J., Wang, S. S., Liu, X. Y., & Li, L. (2019). Clean utilization of waste oil: Soap collectors prepared by alkaline hydrolysis for fluorite flotation. *Journal of Cleaner Production*, *240*, 118179.

[6] Rahayu, S., Pambudi, K. A., Afifah, A., Fitriani, S. R., Tasyari, S., Zaki, M., & Djamahar, R. (2021, April). Environmentally safe technology with the conversion of used cooking oil into soap. In *Journal of Physics: Conference Series* (Vol. 1869, No. 1, p. 012044). IOP Publishing.

[7] Cholifah, U., Nafiunisa, A., Aryanti, N., & Wardhani, D. H. (2021, February). The influence of cocamide DEA towards the characteristics of transparent soap. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1053, No. 1, p. 012016). IOP Publishing.

[8] Handayani, S. S., Gunawan, E. R., Suhendra, D., Murniati, M., & Aditha, I. M. (2020). Karakterisasi Sifat Fisiko Kimia Minyak Nyamplung Sebagai Bahan Baku Sabun Padat Transparan. *Jurnal Pijar Mipa*, *15*(4), 411-415.

[9] Juliansyah, R., & Firawati, F. (2020). Optimasi Konsentrasi Sukrosa Terhadap Transparansi Dan Sifat Fisik Sabun Padat Transparan Minyak Atsiri Sereh Wangi (Cymbopogon citratus L.). *Jurnal Mandala Pharmacon Indonesia*, *6*(2), 91-96.

[10] Rincón, L. A., Ramírez, J. C., & Orjuela, A. (2021). Assessment of degumming and bleaching processes for used cooking oils upgrading into oleochemical feedstocks. *Journal of Environmental Chemical Engineering*, *9*(1), 104610.

[11] Idawati, S., & Sukmana, D. J. (2022). Formulation and evaluation liquid hand soap of celery leaf (Apium graviolens) extract. *Jurnal Pijar Mipa*, *17*(1), 67-72.

[12] Sasongko, H., & Mumpuni, A. S. (2017). Pengaruh penambahan sukrosa terhadap mutu sabun transparan dari ekstrak etanol herba pegagan (Centella asiatica L.). *Pharmaciana*, *7*(1), 71.

[13] Arlofa, N., Budi, B. S., Abdillah, M., & Firmansyah, W. (2021). Pembuatan Sabun Mandi Padat Dari Minyak Jelantah. *Jurnal Chemtech*, *7*(1), 17-21.

[14] Rifkowaty, E. E. (2020). Pengaruh Konsentrasi Sukrosa Dan Gliserin Terhadap Sabun Transparan Daun Ketepeng (Cassia Alata). *JURNAL PATANI: Pengembangan Teknologi Pertanian dan Informatika*, *4*(2), 26-33.

[15] Novianti, R. D., Prabowo, W. C., & Narsa, A. C. (2021, April). Optimasi Basis Sabun Padat Transparan Menggunakan Minyak Zaitun dan Pengaruh Konsentrasi Sukrosa Terhadap Transparansi Sabun: Optimization of Transparent Solid Soap Base Using Olive Oil and the Effect of Sucrose Concentration on Soap Transparency. In *Proceeding of Mulawarman Pharmaceuticals Conferences* (Vol. 13, pp. 164-170).

[16] Setiawati, I., & Ariani, A. (2020). Kajian pH dan Kadar Air dalam Sni Sabun Mandi Padat di Jabedebog. *Prosiding Pertemuan Dan Presentasi Ilmiah Standardisasi*, 293-300.

[17] Robbia, A. Z., Yahdi, Y., & Dewi, Y. K. (2021). Perbandingan pengaruh ekstrak lidah buaya (aloe vera) dan ekstrak daun sirih (piper betle linn) terhadap kualitas produk hand soap. *Jurnal Pijar Mipa*, *16*(2), 228-234.

[18] Febriani, A., Syafriana, V., Afriyando, H., & Djuhariah, Y. S. (2020, September). The utilization of oil palm leaves (Elaeis guineensis Jacq.) waste as an antibacterial solid bar soap. In *IOP Conference Series: Earth and Environmental Science* (Vol. 572, No. 1, p. 012038). IOP Publishing.

[19] Prihanto, A., & Irawan, B. (2018). Pemanfaatan Minyak Goreng Bekas Menjadi Sabun Mandi. *Metana*, *14*(2), 55-59.

[20] Badan Standardisasi Nasional. (1994). *SNI 06-3532-1994 Standar Mutu Sabun Mandi*. Dewan Standardisasi Nasional. Jakarta.