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Formulation and Antimicrobial Activity Evaluation of Liquid Soap Containing SCOBY (Symbiotic Culture of Bacteria and Yeast) and Kombucha from Tea and Lemongrass

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Abstract

Kombucha soap has the ability to inhibit pathogenic microbes. However, the production of soap, particularly kombucha liquid soap, has so far only utilized the kombucha broth. SCOBY, formed from the symbiosis of fungi and bacteria during kombucha fermentation, has potential health benefits, yet its application as an active ingredient in liquid soap has not been explored. This study aimed to formulate liquid soap containing SCOBY and kombucha as active ingredients and to evaluate its antibacterial and antifungal activities. Kombucha was prepared using two fermentation treatments: green tea fermentation (K1) and a combination of green tea with lemongrass decoction (K2). The resulting kombucha broth and SCOBY from each fermentation were used as active ingredients in liquid soap formulations with the following variations: 10% kombucha (K.K), 10% kombucha + 10% SCOBY (K.K+S), and 10% SCOBY (K.S). Each liquid soap was evaluated for its organoleptic properties, hedonic acceptance, antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*, and antifungal activity against *Candida albicans*.The results showed that the best treatment was the liquid soap containing 10% kombucha + 10% SCOBY from green tea fermentation (K1), which exhibited inhibition zones of 1.75 mm against *Staphylococcus aureus*, 7 mm against *Escherichia coli*, and 6 mm against *Candida albicans*. In contrast, the liquid soaps containing 10% kombucha from green tea fermentation (K1) and the combination of green tea and lemongrass fermentation (K2) showed no inhibitory effect against *Candida albicans*. These findings indicate that the addition of SCOBY as an active ingredient can enhance the antimicrobial properties of liquid soap, particularly in inhibiting pathogenic fungi.

Keywords: Lemongrass; kombucha; SCOBY; antibacterial; antifungal.

INTRODUCTION

Kombucha is a fermented tea beverage produced using a symbiotic culture of bacteria and yeast (SCOBY). This drink originated in Manchuria, Southern China during the Tsin Dynasty around 220 BC and later became known as “Kombucha” after being used by Doctor Kombu to treat the digestive disorders of Emperor Inkyo of Japan (Antolak et al., 2021). Kombucha is typically prepared from brewed tea such as green, black, oolong, or white tea, or from other substrates such as butterfly pea flower (Faizah et al., 2024), and is fermented with SCOBY. Although it contains alcohol as a byproduct of fermentation, the alcohol content of kombucha is only 0.055%, which is far below the halal threshold set by MUI (<0.5%) (Riswanto & Rezaldi, 2021).

Fermentation of kombucha produces bioactive compounds and microorganisms with antimicrobial properties. These properties are influenced by the type of substrate used. Green tea kombucha demonstrates stronger inhibitory activity against microorganisms such as *Staphylococcus epidermidis*, *Micrococcus luteus*, *Escherichia coli*, and *Listeria monocytogenes*, while black tea kombucha is more effective against *Staphylococcus aureus* and *Pseudomonas aeruginosa* (Battikh et al., 2013). In addition to tea, other substrates such as turmeric, soursop leaves, and butterfly pea flower have also shown promising antimicrobial activity against *E. coli* and *S. aureus* (Zubaidah et al., 2021; Damayanti & Bintari, 2024), supported by the presence of organic acids, phenolic compounds, and bacteriocins (Zailani & Adnan, 2022). Kombucha is also recognized as a probiotic drink with potential to reduce cholesterol and uric acid levels (Effendi et al., 2014).

One potential herbal substrate for kombucha is lemongrass, which has antimicrobial activity against *E. coli*, *S. aureus*, and *Candida albicans* (Novitri & Kurniati, 2021; Alhabsyie et al., 2024; Fitriani et al., 2013). Lemongrass has been utilized in various health-related products such as mouthwash and soap (Sapitri & Mayasari, 2021; Sikawin et al., 2018; Rifqi et al., 2021). Kombucha prepared from lemongrass infusion has been reported to achieve higher consumer preference compared to tea-based kombucha (Nisak et al., 2023) and shows lower levels of pathogenic contamination (Celestin et al., 2023).

Kombucha can also be applied in biotechnological products such as soap. Butterfly pea kombucha has been investigated as a potential ingredient for liquid soap, dishwashing liquid, feminine hygiene soap, and facial wash, and has demonstrated inhibitory activity against pathogenic microbes such as *S. aureus*, *Salmonella typhi*, *Propionibacterium acnes*, and *C. albicans* (Ma'ruf et al., 2022; Rezaldi et al., 2024; Febriana et al., 2023). However, most applications have focused only on the kombucha liquid, while SCOBY, the solid byproduct of fermentation, remains underutilized despite its potential.

SCOBY (Symbiotic Culture of Bacteria and Yeast) is a cellulose biofilm formed during fermentation, containing bacteria such as *Acetobacter* and *Gluconobacter*, along with yeasts including *Saccharomyces*, *Brettanomyces*, and *Candida* (Jayabalan et al., 2014). Certain strains of *Lactobacillus* and *Bifidobacterium* have also been identified in SCOBY (Wang et al., 2022). During fermentation, yeast hydrolyzes sucrose into glucose and fructose, producing ethanol and CO_2. Lactic acid bacteria convert sugars into lactic acid, while acetic acid bacteria produce acetic acid and gluconic acid (Nyhan et al., 2022). The resulting fermentation broth contains bioactive compounds such as polyphenols, antioxidants, antimicrobial agents (Dartora et al., 2023), as well as probiotics (Laureys et al., 2020).

SCOBY also holds significant potential in health and food applications. Laavanya et al. (2021) reported that SCOBY contains proteins, fibers, lipids, and minerals, and may even be used as animal feed. SCOBY has demonstrated toxin-absorbing activity against foodborne pathogens such as *Penicillium expansum* (Ismaiel et al., 2016), supports wound healing (Jayabalan et al., 2014), and exhibits skin-rejuvenating effects due to its astringent properties, low pH, and cellulose content (Crum & Lagory, 2016). Shoffiya et al., (2025) state that the Scoby Kombucha gel of citrus peel extract has effectiveness on wound healing. The other finding also state that Scoby gel has effectiveness on wound healing of mice, anti-acne effect againts *Staphylococcus aureus* in ear of mice (Nafisah et al, 2025; Ferdyanti et al., 2025).

Based on this potential, the present study aims to formulate a liquid soap preparation using SCOBY and kombucha derived from tea and lemongrass, and to evaluate its inhibitory activity against pathogenic microorganisms, including Gram-negative *Escherichia coli*, Gram-positive *Staphylococcus aureus*, and the pathogenic fungus *Candida albicans*.

MATERIALS AND METHODS

Preparation of Kombucha

The preparation of green tea kombucha (K1) was carried out with modifications to the method of Neffe-Skocinska et al. (2017). A total of 15 g of green tea was weighed, and 1.5 L of water was boiled for each tea preparation. White granulated sugar (150 g) was added to the boiling water and stirred until dissolved. The tea leaves were then steeped in the sugar solution for 15 minutes. The sweet tea was filtered to remove the residue, then transferred into sterile glass jars and left to cool to room temperature (27–30 °C). Once cooled, 75 g of kombucha SCOBY and 90 mL of starter liquid were added, and the jars were covered with sterile cloth. Fermentation was conducted for 14 days (Jayabalan et al., 2010).

The preparation of green tea kombucha with lemongrass addition (K2) was a modification of the methods by Celestin et al. (2023), Nisak et al. (2023), and Neffe-Skocinska et al. (2017). Fresh lemongrass (300 g) was washed, chopped into small pieces, and boiled in 3 L of water at 65 °C for 30 minutes. A total of 1.5 L of the boiled extract was taken, reboiled for 1–5 minutes, and supplemented with 150 g sugar. Green tea (15 g) was added and steeped for 15 minutes. The tea infusion was filtered, placed in sterile glass jars, and cooled to 27–30 °C. SCOBY (75 g) and 90 mL starter liquid was then added, covered with sterile cloth, and fermented for 14 days. The newly formed SCOBY and fermented kombucha were harvested for use in liquid soap preparation.

Preparation of Liquid Soap with Kombucha and SCOBY

The formulation of liquid soap was based on a modification of Prabawardani et al. (2023). The formulations are presented in Table 1.

Table 1. Formulation of Liquid Soap with Kombucha and SCOBY Extracts.

Material	Function	F0	F1	F2	F3	F4
Green tea kombucha (T) / Green tea + Lemongrass kombucha (ST)	Antimicrobial	0%	X	10%	10%	0%
Green tea SCOBY (T) / Green tea + Lemongrass SCOBY (ST)		0%	X	0%	10%	10%
Olive oil	Soap base	15	15	15	15	15
KOH 40%	Foaming agent	8	8	8	8	8
Cocamidopropyl betaine (CAPB)	Surfactant	1	1	1	1	1
Na-CMC	Thickener	1	1	1	1	1
Phenoxyethanol	Preservative	0,5	0,5	0,5	0,5	0,5

Material	Function	F0	F1	F2	F3	F4
BHT	Antioxidant	1	1	1	1	1
Essential oil	Fragrance	1	1	1	1	1
Castor oil	Emollient	1	1	1	1	1
Sodium lactate	Humectant	1	1	1	1	1
Sucrose	Foam booster	1	1	1	1	1
Yogurt	Softening agent	1	1	1	1	1
Kaolin clay	Slip/silky effect	1	1	1	1	1
Distilled water	Solvent	100	100	100	100	100

Preparation began with processing SCOBY. The SCOBY was weighed according to each treatment, mixed with an equal ratio of kombucha liquid, blended until smooth, and filtered for uniform texture (modified from Tanjung et al., 2020). Olive oil (15 mL) was heated at 60–70 °C, then 8 mL of 40% KOH was slowly added while stirring until soap paste formed. Distilled water (15 mL) was added and stirred until homogeneous. CAPB was added, followed by Na-CMC which was allowed to hydrate and thicken. BHT and phenoxyethanol were incorporated, followed by essential oil, to produce the soap base. Distilled water was added to adjust the volume to 100 mL. Additional ingredients (castor oil, sodium lactate, sucrose, yogurt, kaolin clay) were mixed into the formulation. Finally, SCOBY and kombucha were added as active agents according to each treatment (Prabawardani et al., 2023).

Data Analysis

Organoleptic Test of SCOBY and Kombucha

Observations included pH, color, and aroma of kombucha (before and after fermentation), as well as diameter and weight of SCOBY produced.

Liquid Soap Quality Tests

Liquid soap samples formulated with kombucha and SCOBY (K1.K = 10% kombucha; K1.K+S = 10% kombucha + 10% SCOBY; K1.S = 10% SCOBY) and with kombucha and SCOBY plus lemongrass (K2.K, K2.K+S, K2.S) were evaluated following Widiyanti et al. (2024). The tests included organoleptic evaluation, homogeneity, pH measurement, foam height, and free alkali. **Organoleptic Evaluation**: Preference and Just About Right (JAR) tests were conducted with 15 panelists using questionnaires. **pH Test**: One gram of liquid soap was diluted in 10 mL distilled water, and pH was measured using a digital pH meter.**Foam Height Test**: One gram of soap was mixed with 9 mL distilled water in a test tube and vortexed at 300 rpm for 1 minute. Foam height was measured immediately and again after 5 minutes. **Free Alkali/Free Fatty Acid Test**: Five grams of liquid soap were dissolved in 100 mL ethanol (96%) with phenolphthalein as an indicator. The solution was heated in a water bath for 30 minutes. A pink color indicated free alkali, determined by titration with 0.1 N HCl. If no color change occurred, free fatty acids were determined by titration with 0.1 N KOH.

Antimicrobial Activity of Kombucha and SCOBY Soap

Antimicrobial testing of liquid soap formulations (K1.K, K1.K+S, K1.S, K2.K, K2.K+S, K2.S) was carried out using the disk diffusion method. Mueller Hinton Agar (MHA, 38 g/L) was used for *E. coli* and *Staphylococcus aureus*, while Sabouraud Dextrose Agar (SDA, 45 g/L) was used for *Candida albicans* (Battikh et al., 2011). The bacterial strains were suspended in 0.9% NaCl to match a 0.5 McFarland turbidity standard (Rahmawati et al., 2024). Sterile cotton swabs were dipped into each suspension and streaked across the surface of the respective agar plates. Antimicrobial testing followed the method of Rezaldi et al. (2024), where sterile paper disks were soaked in liquid soap samples, placed on inoculated media, and incubated to observe inhibition zones.

RESULTS AND DISCUSSION

Organoleptic Test of SCOBY and Kombucha

The organoleptic test was conducted on the SCOBY formed and the kombucha produced from the fermentation of green tea and a combination of green tea and lemongrass infusion. The observation results are presented in Table 2.

Table 2. Results of Organoleptic Test of SCOBY and Kombucha.

Treatment		Before Fermentation		After Fermentation		pH	Diameter of Scoby (cm)	Weight of Scoby (gram)
		Aroma	Color	Odor	Color			
K1	Scoby	-	-	-	Yellowish white		15,3	43
	Kombucha	Tea aroma	Dark Brown	Tea aroma with sour smell	Yellowish	2		
K2	Scoby	-	-	-	Yellowish white		16	50

Treatment	Before Fermentation		After Fermentation		pH	Diameter of Scoby (cm)	Weight of Scoby (gram)
	Aroma	Color	Odor	Color			
Kombucha	Tea and lemongrass aroma	Dark Brown	Tea and Lemongrass aroma with sour smell	Yellowish	2		

Note: K1: Kombucha from green tea fermentation, K2: Kombucha from fermentation of green tea and lemongrass infusion.

The observations showed that there was no difference in the color of kombucha from the two types of fermentation (before or after). However, differences were found in the aroma as well as the diameter and weight of the SCOBY produced, where SCOBY with the addition of lemongrass infusion had greater weight and diameter compared to SCOBY from fermentation without lemongrass. It is suspected that the addition of lemongrass infusion influenced the bacterial community during the fermentation process and created differences in the SCOBY produced.

Quality Test of Liquid Soap

The quality test of liquid soap was carried out to evaluate whether the produced liquid soap met the SNI 4085:2017 standard. The data from the liquid soap quality test are presented in Table 3.

Table 3. Results of Quality Test of Liquid Soap Containing Kombucha and SCOBY.

Treatment		pH	Foam Height (mm)		Free Fatty Acid
			Initial	End	
K1	K	9,4	6	6	0,96 %
	K+S	9,7	3	3	1,47 %
	S	9,5	4	4	1,02 %
K2	K	9,4	11	11	0,96 %
	K+S	9,6	5	5	1,41 %
	S	9,7	12	12	1,02 %
Control		9,8	11	11	0,56 %
SNI Standar 4085:2017		4 - 10	≥ 150	≥130	4%

Note: K1: Kombucha without lemongrass infusion, K2: Kombucha with lemongrass infusion, K: Liquid soap with kombucha, K+S: Liquid soap with kombucha and SCOBY, S: Liquid soap with SCOBY, Control: Soap base.

The results of the liquid soap quality test showed that the pH of liquid soap met the SNI 4085:2017 standard, which ranges from 4 to 10. The pH of the liquid soap in each treatment was around 9, meaning that the pH of kombucha- and SCOBY-based liquid soap was in accordance with the SNI standard.

The free fatty acid test was initiated by mixing liquid soap with 96% alcohol and heating until boiling, then phenolphthalein indicator was added. If the solution turned pink, the test performed was for free alkali, because the color change indicates un-saponified alkali in the soap. If there was no color change, the test measured free fatty acids, which indicates fatty acids that were not properly saponified (Rahmawati et al., 2024). In this study, the liquid soap did not change color after being added with phenolphthalein, therefore the test measured free fatty acids. Free fatty acids, also known as oleic acid, are compounds that can reduce the soap's ability to bind dirt, oil, or sweat, thus reducing its cleansing ability. Based on SNI 4085:2017, free fatty acid content in liquid soap must not exceed 4%. The free fatty acids in kombucha- and SCOBY-based liquid soap in this study ranged between 0.9% and 1.4%, which complies with the SNI standard.

The foam height measurement showed that the liquid soap foam height did not meet the SNI standard. According to SNI 4085:2017, liquid soap foam height based on the Ross-Miles test should be ≥150 mm initially and ≥130 mm after 5 minutes. The foam height of liquid soap in all treatments ranged between 6–12 mm. However, the foam was categorized as stable because there was no reduction after 5 minutes. Foam height is one of the quality parameters in liquid soap testing to indicate the amount of foam produced by surfactants in the soap formula (Martihandini et al., 2024). The addition of certain active ingredients may reduce foam ability. Setyowati et al. (2025) stated that soap with added lemongrass extract had foam heights below the standard, as lemongrass extract affected the emulsifying ability of sodium lauryl sulfate as a surfactant. Ho et al. (2022) also reported that free fatty acids can affect foam height. The kombucha- and SCOBY-based liquid soap in this study still contained free fatty acids, although within the SNI standard, and these were suspected to contribute to the low foam height.

Hedonic Test of Liquid Soap with Kombucha and SCOBY

The hedonic test was conducted on 15 panelists with evaluated categories including aroma, color, viscosity, foam, ease of rinsing, skin feel, irritation, and overall preference. The average score of the panelists' assessments is presented in Table 4.

Table 4. Hedonic Test Results of Liquid Soap with Kombucha and SCOBY.

Sample	Aroma	color	Viscocity	Foam	Ease of rinsing	Skin Feel	Iritation	Overall Preference
K1.K	4	3	3	3	4	4	3	4
K1.K+S	4	3	3	3	4	4	3	4
K1.S	3	3	3	4	4	4	3	4
K2.K	4	3	3	4	4	4	3	4
K2.K+S	4	3	3	3	3	4	3	4
K2. S	4	3	3	4	4	4	3	4
K	4	4	3	3	4	4	3	3

Note: Scale: 1 = Strongly Dislike, 2 = Dislike, 3 = Neutral, 4 = Like, 5 = Strongly Like. K1: Green tea kombucha, K2: Green tea kombucha with lemongrass infusion, K: Liquid soap 10% kombucha, K+S: Liquid soap 10% kombucha + 10% SCOBY, S: Liquid soap 10% SCOBY, Control: Soap base.

The results showed that aroma received a score of 4 (Like) in all treatments except for SCOBY soap from green tea kombucha, which received a neutral score (3). Panelists gave a neutral rating (3) for aroma, viscosity, and irritation in most treatments, except the control which scored 4. The addition of SCOBY and kombucha changed the soap's color, making it cloudy and less appealing. All treatments scored 4 for ease of rinsing, indicating that the liquid soap did not leave residue when washed off with water. Overall, panelists liked the liquid soap products in all treatments, except the control which scored lower.

Just About Right (JAR) Test of Liquid Soap with Kombucha and SCOBY

The JAR test was conducted as a final evaluation to complement the hedonic test. This test is useful for product development and optimization by assessing sensory intensity with three specific levels: too low, just right, and too high (Narayan et al., 2014). The JAR test for liquid soap emphasized four categories: aroma, viscosity, foam, and skin smoothness after rinsing. Results are shown in Table 5.

Table 5. Just About Right (JAR) Test Results of Liquid Soap with Kombucha and SCOBY.

Sample	Aroma Intensity	Viscocity	Foam	Smoothness after rinsing
K1.K	3	1	1	3
K1.K+S	3	1	1	3
K1.S	3	1	1	3
K2.K	3	1	1	3
K2.K+S	3	1	1	3
K2. S	3	1	1	3
K	3	3	1	3

Note: Scale: 1 = Too Low, 3 = Just Right, 5 = Too High. K1: Green tea kombucha, K2: Green tea kombucha with lemongrass infusion, K: Liquid soap 10% kombucha, K+S: Liquid soap 10% kombucha + 10% SCOBY, S: Liquid soap 10% SCOBY, Control: Soap base.

The JAR test results indicated that all treatments received a score of 3 for aroma intensity and smoothness after rinsing, including the control. This showed that the soap's aroma was considered appropriate by the panelists and that it rinsed off easily. However, liquid soaps with kombucha and SCOBY scored 1 for viscosity, except for the control. The addition of SCOBY and kombucha reduced viscosity, making the soap thinner. This also affected foam formation, as panelists noted that the foam produced was too low. This observation was consistent with the foam height measurement (Table 3), which showed that foam height in the liquid soap did not meet the SNI standard.

Antibacterial Test of Liquid Soap

The antibacterial test was conducted on liquid soap to evaluate the ability of its active ingredients in inhibiting or killing pathogenic bacteria *Staphylococcus aureus* and *Escherichia coli*, as well as the pathogenic fungus *Candida albicans*. The results of the antibacterial test are presented in Table 6.

Table 6. Antibacterial Test of Liquid Soap Containing Kombucha and SCOBY against Pathogenic Microbes.

Treatment		Inhibition Zone (mm)			Remarks
		S. Aureus	*E. Coli*	*C. Albicans*	
K1	K	1,25	4,25	0	> 20 mm : Very Strong 10-20 mm : Strong 5-10 mm : Weak <5 mm: Sangat Very Week
	K+S	1,75	7	6	
	S	1,5	6	2,5	
K2	K	1,75	3	0	
	K+S	1,25	2,5	0	
	S	1,5	3	0	
K+		21	26	23	
K-		0	0	0	

Note: K1: Kombucha without lemongrass infusion; K2: Kombucha with lemongrass infusion; K+: Positive control using commercial liquid soap; K–: Negative control using liquid soap base; K: Liquid soap with kombucha; K+S: Liquid soap with kombucha and SCOBY; S: Liquid soap with SCOBY.

The results showed that the addition of SCOBY into liquid soap influenced its ability to inhibit the growth of pathogenic bacteria and fungi. Green tea kombucha prepared with and without lemongrass infusion produced different outcomes as active ingredients in soap. Liquid soap containing green tea kombucha without lemongrass infusion (K1.K) exhibited the highest inhibition zone against *E. coli* (4.25 mm), but this was categorized as very weak. The addition of SCOBY increased the inhibition zone against *E. coli* to 7 mm, which falls into the moderate category. Treatments with kombucha and SCOBY also demonstrated the highest inhibition zones against *Staphylococcus aureus* (1.75 mm, weak category) and *Candida albicans* (6 mm, moderate category). SCOBY showed antifungal properties, as indicated by liquid soap containing SCOBY (K1.S), which exhibited a 2.5 mm inhibition zone against *Candida albicans*, compared to kombucha-only formulations.

According to Jayabalan et al. (2014) and Villarreal-Soto et al. (2019), fermentation of green tea into kombucha by SCOBY produces metabolites such as organic acids, ethanol, and phenolic compounds that can inhibit pathogenic fungi like *Candida albicans*. Chakravorty et al. (2016) also reported that the addition of SCOBY biomass during fermentation and fermentation duration influence kombucha's antimicrobial activity. This aligns with the present study, where the addition of SCOBY as an active ingredient enhanced the antifungal capacity of liquid soap.

Fermentation of green tea kombucha with lemongrass infusion yielded different results as an active ingredient in liquid soap. Kombucha and SCOBY-based liquid soap fermented with lemongrass infusion showed very weak inhibitory activity against pathogenic bacteria and no inhibitory effect against pathogenic fungi across all treatments. It is presumed that lemongrass infusion during fermentation suppressed certain microbial populations beneficial for inhibiting pathogens.

Lemongrass contains bioactive antifungal compounds such as citral and geraniol, which are known to inhibit several pathogenic fungi (Burt, 2004; Kumar et al., 2018). These bioactive compounds may alter microbial population dynamics and the metabolites produced. Marsh et al. (2014) noted that microbial population dynamics during kombucha fermentation can be influenced by fermentation time, with microbial communities shifting over time, thereby affecting metabolite profiles. Tunjungsari and Fikroh (2024) also reported that the addition of roselle in green tea fermentation altered kombucha's antioxidant activity. Therefore, in this study, lemongrass infusion affected the antifungal properties of kombucha- and SCOBY-based liquid soap, resulting in no detectable antifungal activity.

CONCLUSIONS

This study demonstrated that liquid soap containing SCOBY and kombucha as active ingredients had a pH (9.4–9.7) and free fatty acid levels (0.9–1.4%) that met the standards of SNI 4085:2017, although its foam height remained far below the required standard. Hedonic and JAR tests indicated good acceptance in terms of fragrance, rinsability, and skin feel, despite weaknesses in color, viscosity, and foaming. Antibacterial tests revealed that soap formulated with SCOBY and green tea kombucha without lemongrass was the most effective, showing weak to moderate inhibition zones against *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*. Therefore, SCOBY holds significant potential as a natural active ingredient in liquid soap, though formulation optimization is necessary to enhance its biological effectiveness and sensory quality

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REFERENCES

Alhabsyie, F.A.M., Tilaqza, A., Wulandari, D.N. (2024). Uji in vitro aktivitas antimikroba ekstrak etanol serai dapur (*Cymbopogon citratus)* terhadap *Staphylococcus aureus. Jurnal Bio Komplementer Medicine, 11(1).*

Antolak, H., Piechota, D., & Kucharska, A. (2021). Kombucha Tea- A Double Power of Bioactive Compounds from Tea and Symbiotic Culture of Bacteria and Yeasts (SCOBY). *Antioxidants, 10, 1541.*

Battikh, H., Chaieb, K., Bakhrouf, A., & Ammar, E. (2013). Antibacterial and antifungal activities of black and green kombucha teas. *Journal of Food Biochemistry*, *37*(2), 231–236. https://doi.org/10.1111/j.1745-4514.2011.00629.x

Battikh, H., Chaieb, K., Bakhrouf, A., & Ammar, E. (2013). Antibacterial and antifungal activities of black and green kombucha teas. *Journal of Food Biochemistry*, *37*(2), 231–236. https://doi.org/10.1111/j.1745-4514.2011.00629.x

Celestin, T.C.K., Berenice, H.G.M.J., Yaya, K., Pelagie, Y., Sylvain, K., Justin, G.G., Pivot, S., Jultesse, B.S.B., Pascal, A.D.C., Innocent, B.Y., & Clement, A. (2023). Microbiological, physicochemical and nutritional assessment quality of three types of kombucha drinks produced from local herbs and lipton tea in Benin. *American journal of food and nutrition, 11(1): 46-54.*

Chakravorty, S., Bhattacharya, S., Chatzinotas, A., Chakraborty, W., Bhattacharya, D., & Gachhui, R. (2016). Kombucha tea fermentation: Microbial and biochemical dynamics. *International Journal of Food Microbiology, 220*, 63–72.

Crum, H., & LaGory, A. (2016). *The big book of kombucha: brewing, flavoring, and enjoying the health benefits of fermented tea*. Storey Publishing.

Damayanti, D. S., & Bintari, Y.R. (2024). Antibacterial and antioxidant potensial of three kinds of Kombucha. *Jurnal kedokteran syiah kuala, 24(3): 37228.*

DARTORA, B., SANT'ANNA, V., HICKERT, L. R., FENSTERSEIFER, M., AYUB, M. A. Z., FLÔRES, S. H., & PEREZ, K. J. (2023). Factors influencing kombucha production: effects of tea composition, sugar, and SCOBY. *Food Science and Technology*, *43*. https://doi.org/10.5327/fst.8123

Effendi, F., Roswiem, A. P., & Stefani, E. (2014). Uji aktifitas antibakteri teh kombucha probiotik terhadap bakteri *Escheria coli* dan *Staphylococcus aureus.* Jurnal Fitofarma, 4(2).

Faizah., Khairunnisa, A., Latifasari, N., & Dyah Kurniawati, A. (2024). *KOMBUCHA DAN SIFAT FUNGSIONALNYA: STUDI PUSTAKA [Kombucha and its Functional Properties: A Review]*. *Jurnal Sains dan Teknologi Pangan,* 9, (5), 7729-7741.

Febriana, L., Premihadi, P., Priyoto,. Rezaldi, F., Erikania, S., & Nurmaulawati, R. (2023). Uji Daya Hambat Propinobacterium Acnes Pada Produk Bioteknologi Farmasi Sediaan Sabun Wajah Kombucha Bunga Telang (*Clitoria Ternatea* L). *Jurnal Farmagazine X, 10 (1), 70–78.*

Ferdyanti, A.P., Agustina, E., Faizah, H., Purnamasari, R. Effect of Different Concentration o Scoby Kombucha as an Anti-acne Against *Staphylococcus aureus* in The Ear of Mice (*Mus musculus*). *Biology, Medicine, & Natural Product Chemistry journal*, 14(2): 1143-1150.

Fitriani, E., Alwi, M., Umrah. (2013). Studi Efektivitas Ekstrak Daun Sereh Wangi (*Cymbopogon nardus* L). sebagai anti fungi *Candida albicans. Jurnal Biocelebes, 7(2) : 15-20;*

Ho, T.M., Bhandari, B.R., Bansal, N. (2023). Effect of shearing-induced lipolysis in foaming properties of milk. *Journal of the science of food and agriculture, 103: 5312-5321.*

Ismaiel, A. A., Bassyouni, R. H., Kamel, Z., & Gabr, S. M. (2016). Detoxification of patulin Kombucha tea ameliorates experimental auto immune by kombucha tea culture. *CyTA - Journal of Food*, 14, 271–279.

Jayabalan, R., Malbaša, R. v., Lončar, E. S., Vitas, J. S., & Sathishkumar, M. (2014). A review on kombucha tea-microbiology, composition, fermentation, beneficial effects, toxicity, and tea fungus. In *Comprehensive Reviews in Food Science and Food Safety* (Vol. 13, Issue 4, pp. 538–550). Blackwell Publishing Inc. https://doi.org/10.1111/1541-4337.12073

Jayabalan, R., Malini, K., Sathiskumar, M., Swaminathan, K., & Yun, S, E. (2010). Biochemical Characteristic of Tea Fungus Produced During Kombucha Fermentation. *Food Sci Biotechnol, 19*, 843–847 https://doi.org/10.1007/s10068-010-0119-6

Kumar, V., & Joshi, V. K. (2016). Kombucha: Technology, microbiology, production, composition and therapeutic value. International Journal of Food and Fermentation Technology, 6(1), 13-24.

Laavanya, D., Shirkole, S., & Balasubramanian, P. (2021). Current challenges, applications and future perspectives of SCOBY cellulose of Kombucha fermentation. In *Journal of Cleaner Production* (Vol. 295). Elsevier Ltd. https://doi.org/10.1016/j.jclepro.2021.126454

Laureys, D., Britton, S. J., & de Clippeleer, J. (2020). Kombucha Tea Fermentation: A Review. In *Journal of the American Society of Brewing Chemists* (Vol. 78, Issue 3, pp. 165–174). Taylor and Francis Inc. https://doi.org/10.1080/03610470.2020.1734150

Ma'ruf, A., Safitri, E., Ningtias, R. Y., Pertiwi, F. D., Rezaldi, F. (2022). ANTIBAKTERI GRAM POSITIF DAN NEGATIF DARI SEDIAAN SABUN CUCI PIRING FERMENTASI KOMBUCHA BUNGA TELANG (Clitoria ternatea L) SEBAGAI PRODUK BIOTEKNOLOGI FARMASI. In *JUKEKE*, 1(2), 16-25.

Marsh, A. J., O'Sullivan, O., Hill, C., Ross, R. P., & Cotter, P. D. (2014). Sequence-based analysis of the bacterial and fungal compositions of multiple kombucha (tea fungus) samples. *Food Microbiology, 38*, 171–178.

Nafisah, R.F., Agustina, E., Purnamasari, R., Andiarna, F., Hidayati, I. Effectiveness and role of symbiotic culture of bacteria and yeast (SCOBY) kombucha gel on incisional wound healing in mice (*Mus musculus*). *Biota journal,* 10(3): 331-344.

Neffe-Skocińska, K., Sionek, B., Ścibisz, I., & Kołożyn-Krajewska, D. (2017). Acid contents and the effect of fermentation condition of Kombucha tea beverages on physicochemical, microbiological and sensory properties. *CyTA - Journal of Food*, *15*(4), 601–607. https://doi.org/10.1080/19476337.2017.1321588

Nisak, Y.K., Khurniyati, M. I., Nurbaya. S.R., & Nugroho, E.D. (2023). Hedonic test and hedonic quality test of kombucha from various types of indonesia herbs. *Jurnal iptek media komunikasi teknologi, 27(2): 141-150.*

Novitri, S.A., Kurniati, N.F. (2021). Pengaruh Kombinasi Ekstrak Etanol Kulit Buah Delima (*Punica granatum* L.) dengan Batang Sereh (*Cymbopogon citratus)* Terhadap Bakteri *Escherichia coli* ATCC 8739. *Jurnal kesehatan medika saintika,*12(1): 198-204.

Nyhan, L. M., Lynch, K. M., Sahin, A. W., & Arendt, E. K. (2022). Advances in Kombucha Tea Fermentation: A Review. In *Applied Microbiology*, 2, (1), 73–103. https://doi.org/10.3390/applmicrobiol2010005

Prabawardani, S., Fadillah, M.F., Trisnawati, D., Rezaldi, F., Kusumiyati, & Mathar, I. (2023). In vitro pharmacological activity test on pharmaceutical biotechnology products in the form of kombucha bath soap pineapple honey Subang as antibacterial gram positive and negative. *Jurnal biologi tropis, 23(2): 145-153.*

Rahmawati, T. A., Junitasari, A., Rosahdi, T.D. (2024). Aktivitas Antibakteri Streptococcus pyogenes Terhadap Sediaan Sabun Mandi Cair Kombucha Berbasis Ekstrak Kulit Buah Manggis (*Garcinia mangostana* L). *Seminar Nasional Kimia 2024 UIN Sunan Gunung Djati, 41-49.*

Rezaldi, F., Nurmayulis, N., Rusmana, R., Yenny, R. F., & Rustini, R. (2024). *PRODUK BIOTEKNOLOGI FARMASI BERUPA SEDIAAN SABUN CUCI TANGAN KOMBUCHA BUNGA TELANG SEBAGAI ANTIBAKTERI STAPHYLOCOCCUS AUREUS DARI ISOLAT USUS SAPI*. *5*(2), 270.

Rifqi, M., Kusumawardani, I.M., Mastur, L., Harismah, K. (2021). Pembuatan sabun padat antibakteri dari ekstrak daun stevia (*Stevia rebaudiana Bertoni)* dan Sereh wangi. *Seminar nasional pendidikan biologi dan sainteks ke-vi, 423-427.*

Riswanto, D., & Rezaldi, F. (2021). KOMBUCHA TEA: A STUDY ON THE HALAL OF FERMENTED DRINKS. *IJMA: International Journal Mathla'ul Anwar of Halal Issues*, *1*(2). Function

Sapitri, A., Mayasari, U. (2021). Formulasi sediaan obat kumur dari infusa daun sereh wangi (*Cymbopogon winterianus jowitt* Ex Bor). *jurnal health sains, 2(3): 286-293. Function*

Setyowati, E., Nisa, N.F.H., Nasriyah, Nilawati. (2025). Physical stability test of liquid facial soap formulation of citronella extract (*Cymbopogon nardus* L). *Scientific journal of pharmacy,* 21(1).

Shoffiya, A.N., Agustina, E., Andiarna, F., Hidayati, I., Purnamasari, R. Effect of variation in concentration of Scoby kombucha gel citrus peel extract (*citrus nobilis)* on wound incision (*vulnus scissum*) in mice (*Mus musculus). International journal of applied biology, 9(1):26-34.*

Sikawinm B.M.B., Yamlean, P.V.Y., Sudewi, S. (2018). Formulasi sediaan gel antibakteri ekstrak etanol tanaman sereh (*Cymbopogon citratus (*DC.) dan uji aktivitas antibakteri (*Staphylococcus aureus)* secara *in vitro. Jurnal ilmiah farmasi, 7(3) : 302- 310.*

Tanjung, A., Prasetyati, S. B., Wardani, A. K., & Saputra, R. S. H. (2020). Pengaruh Penambahan Arang Aktif Terhadap Mutu Sabun Mandi Cair Rumput Laut (Gracilaria sp.). *PELAGICUS*, *1*(1), 31. https://doi.org/10.15578/plgc.v1i1.8651

Tunjungsari, G. P., & Fikroh, R. A. (2024). *Comparison of Antioxidant Activity and Chemical Profile between Green Tea Kombucha with Green Tea and Rosela Combination Kombucha*. Bioscientist: Jurnal Ilmiah Biologi, 12(1), 757–771.

Villarreal-Soto, S. A., Beaufort, S., Bouajila, J., Souchard, J. P., & Taillandier, P. (2018). Understanding Kombucha Tea Fermentation: A Review. In *Journal of Food Science* (Vol. 83, Issue 3, pp. 580–588). Blackwell Publishing Inc. https://doi.org/10.1111/1750-3841.14068

Wang, B., Rutherfurd-Markwick, K., Zhang, X. X., & Mutukumira, A. N. (2022). Kombucha: Production and Microbiological Research †. In *Foods* (Vol. 11, Issue 21). MDPI. https://doi.org/10.3390/foods11213456

Zailani, N. S., & Adnan, A. (2022). Substrates and metabolic pathways in symbiotic culture of bacteria and yeast (SCOBY) fermentation: A mini review. *Jurnal teknologi (Sciences & Engineering), 84(5), 155-165.*

Zubaidah, E., Nisak, Y. K., Wijayanti, S. A., & Christianty, R. A. (2021). Characteristic of microbiological, chemical, and antibacterial activity of turmeric (Curcuma longa) kombucha. *IOP Conference Series: Earth and Environmental Science*, *924*(1). https://doi.org/10.1088/1755-1315/924/1/012080