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RESEARCH ARTICLE

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ECO-FRUIT SOAP: FORTIFICATION OF SUSTAINABLE SOAP ZERO FROM FOOD WASTE AS A PRE-CURSOR IN DEVELOPING A GUIDEBOOK

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ABSTRACT

This study addresses environmental concerns by enhancing a recycled food waste soap to improve its antimicrobial properties and pass physicochemical analysis. Researchers modified the sustainable soap formula by incorporating lemon peels, eggshell membrane, lemongrass essential oils, and various fruit peels. Laboratory testing confirmed that the mango and pineapple variations of the soap both met the standard pH levels for acceptable soap products, and their antimicrobial analysis demonstrated inhibitory activity against common bacteria. The dehydrated pineapple peel variation displayed a slightly better zone of inhibition against these organisms compared to the mango variation, indicating its potential as a more effective alternative. This research underscores the importance of recycling by-products to create sustainable solutions and contribute to environmental conservation efforts.

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INTRODUCTION

In recent decades, global environmental changes have intensified, leading to more pronounced climate shifts, including the escalation of extreme weather events such as stronger typhoons. The primary driver of climate change is attributed to increased manufacturing and economic activities resulting in elevated emissions of greenhouse gases, particularly carbon dioxide and methane (Mikhaylov et al., 2020). As societal awareness of sustainability grows, the hospitality industry, a significant contributor to the Philippines' GDP, faces challenges in waste management. A substantial portion of municipal solid waste, notably biodegradable waste, originates from food establishments, retailers, and households, contributing to environmental concerns (Cos, 2020; Dela Peña, 2021). Focusing on the Philippines' key fruit exports—mango, banana, and pineapple—the study highlights the considerable waste generated, with mango alone producing 46,963 metric tons of waste, underscoring the need for innovative approaches to address agricultural by-products (Department of Agriculture - Bureau of Agricultural Research, 2022). Recognizing the environmental impact, the researchers propose a novel approach by utilizing fruit waste, particularly mango and pineapple peels, to fortify the antimicrobial properties of Soap Zero, aiming to contribute to sustainability and waste reduction in the hospitality industry. This study stems from the researchers' observations during their internship in the hotel industry, where they identified significant waste production, motivating them to address food waste management through the innovative application of by-products in the creation of a new, fortified variant of Soap Zero with potentially enhanced antimicrobial capabilities.

METHODOLOGY

The study employed R.A. Fisher's experimental design from the 1920s and 1930s, comparing two factors in two groups to assess differences in soap formulations. Utilizing Soap Zero as the base, the research replaced the original fruit peel powder with Mango and Pineapple peel powders sourced from local vendors. Additional components, including lemon peels and eggshell membrane, were incorporated to enhance antimicrobial properties. Coconut oil and lemongrass essential oil were prepared, while waste cooking oil was purified using activated charcoal. The soap production took place in Ashton Field Subdivision, Brgy. Milagrosa, Calamba, Laguna. Mango, pineapple, lemon peels, and eggshells were sourced fresh from local vendors, rinsed, and dehydrated before use. The dehydrating process involved washing, dehydrating, and powdering the peels and eggshell membrane. Purifying waste cooking oil was done through a filtration and activated charcoal process, aiming for 130 ml of purified oil. The study assessed soap's antimicrobial properties at the Department of Science and Technology (DOST), aiming to identify the most effective agent against Escherichia coli, Staphylococcus aureus, and Salmonella Typhimurium, ensuring safety through physicochemical testing and ethical considerations. The results from DOST are essential for evaluating the safety and antimicrobial effectiveness of the two new soap variations, with statistical tools and the disc diffusion method utilized for analysis.

RESULTS AND DISCUSSIONS

Table 1 reveals the moisture content of the Pineapple Bar and Mango Bar variants of sustainable soap. The Pineapple variant has a moisture and volatile matter content of 44.1%, while the Mango variant has 42.2%, both deriving their moisture from the same liquid content. The higher moisture content in the Pineapple Bar Soap, as per Dema et al. (2022), could lead to the formation of free fatty acids, glycerol, and hydrolysis, negatively affecting soap quality and shelf life. Soap-making relies on alkali, specifically sodium hydroxide (NaOH) for bar soap and potassium hydroxide (KOH) for liquid soap. In this study, NaOH is used to craft high-quality solid soap (Gelaye, 2018). The table indicates that the Mango variant contains more free alkali than the Pineapple variant, exceeding the standard for commercially available hand bar soap products. Acceptable free alkali levels are less than 0.5% for NaOH-based soap and less than 0.14% for KOH-based soap, based on Alcantara et al. (2022). Both variants surpass the NaOH-based standard, with the Mango variant at 0.706% and the Pineapple at 0.542%.

Table 3 shows the pH levels of the researchers' sustainable soap creations. The Mango variation has a pH level of 9.70, while the Pineapple variation has 9.63. Both variations fall within the safe pH range for common soaps, typically between 8 and 10. This aligns with prior research indicating that soaps with a pH value ranging from 4 to 10.5 are skin-friendly. Table 4shows the antimicrobial zones of inhibition for mango and pineapple Soap Zero variations against E. coli. The pineapple variation consistently had the highest inhibition zones, with a mean of 13.09, while the mango variation had the lowest mean at 12.50.In a study by Crebello et al. (2019), ripe mango peel extract was used in soap making via cold saponification. Their soap exhibited a smaller zone of inhibition (4mm) against E. coli compared to the mango variation of Soap Zero, which had a mean inhibition zone of 12.50mm using green mango peel powder. In Table 5, the antimicrobial effectiveness of two Soap Zero variations, mango, and pineapple, against Escherichia coli is assessed. Both variations exhibit mild reactivity with a complete inhibitory rating but are considered resistant as per established criteria for Escherichia coli. Table 6 presents the Zone of Inhibition for sustainable soaps against Staphylococcus aureus. Each soap was measured three times and averaged, resulting in the Mango Bar Soap with a mean of 18.13mm and the Pineapple Bar Soap with a mean of 19.01mm, both effectively inhibiting Staphylococcus aureus. The superior antimicrobial effectiveness of the Pineapple Bar Soap is attributed to its natural acidity, supported by studies showing pineapple's high acidity, proteolytic compound bromelain, flavonoids, and vitamin C's role in inhibiting Staphylococcus aureus growth. Table 7 displays the antimicrobial effectiveness of Mango Bar Soap and Pineapple Bar Soap against the common household bacterium, Staphylococcus aureus. Both soap variants demonstrate susceptibility in inhibiting this bacterium, likely attributed to ingredients in the soap's new

Table 1. Physicochemical Analysis for the Moisture and Volatile Matter Content for the Pineapple and Mango variation of Soap Zero

Sample Name and Code	Moisture and Volatile Matter, % w/w	Test Method
Pineapple Bar Soap (OCS-2023-0693)	44.1	PNS 39:2003
Mango Bar Soap (OCS-2023-0692)	42.2	

Reference: Philippines National Standard 39:2003 Toilet Soap - Specific, Bureau of Product Standards, 2003

Table 2. Physicochemical Analysis for the Free Alkali Content for the Pineapple and Mango variation of Soap Zero

Sample Name and Code	Free Alkali (as Na2O), % w/w	Test Method
Pineapple Bar Soap (OCS-2023-0693)	0.542	PNS 39:2003
Mango Bar Soap (OCS-2023-0692)	0.706	

Reference: Philippines National Standard 39:2003 Toilet Soap - Specific, Bureau of Product Standards, 2003

Table 3. Physicochemical Analysis for the pH Level Content for the Pineapple and Mango variation of Soap Zero

Sample Name and Code	pH @24.0°C, % w/w	Test Method
Pineapple Bar Soap (OCS-2023-0693)	9.63	PNS 39:2003
Mango Bar Soap (OCS-2023-0692)	9.70	

Reference: Philippines National Standard 39:2003 Toilet Soap - Specific, Bureau of Product Standards, 2003

Table 4. Zone of Inhibition of Mango and Pineapple soap formulation against Escherichia coli

Sample/Control	Escherichia coli (ATCC 25922) Zone of Inhibition (mm)				
	Replicate 1	Replicate 2	Replicate 3	Mean	SD
Bar Soap with Mango (10mm)	12.62	13.22	11.67	12.50	0.78
Bar Soap with Pineapple (10mm)	13.11	14.12	12.05	13.09	1.04
Positive Control: Amikacin 30 ug (6mm)	13.07	12.88	13.07	13.01	0.11
Negative Control: Sample-free disc (10mm)	0.00	0.00	0.00	0.00	-

Table 5. Antimicrobial capability of Mango and Pineapple soap formulation against Escherichia coli

Sample/Control	Escherichia coli (ATCC 25922)		
	Reactivity	Inhibitory Activity	Characteristic
Bar Soap with Mango (10mm)	2	+++	Resistant
Bar Soap with Pineapple (10mm)	2	+++	Resistant
Positive Control: Amikacin 30 ug (6mm)	3	+++	Resistant
Negative Control: Sample-free disc (10mm)	0	(-)	Resistant

Legend: Inhibitory Activity Rating: (+++) Complete; (++) partial; (+) slight, and (-) negative formulation, including dehydrated lemon peels. Citrus peels, particularly lemon (citrus limon), have been documented to exhibit antibacterial activity, as supported by Santhosh et al. (2015). Both soaps receive a reactivity rating of 3, indicating a moderate response to the tested bacteria, and the natural ingredients in the fortified soap, rich in citral and limonene, serve as antimicrobial agents. According to Wifek et al. (2016), these constituents contribute to the soap's bactericidal and antimicrobial properties. Both variants display complete inhibitory activity against the tested bacterium, suppressing bacterial growth where the soap sample is placed on sterile agar plates.

Table 8 reveals the zone of inhibition for mango and pineapple soaps against Salmonella Typhimurium, with each soap variant measured three times and averaged. The positive control used was 6mm Amikacin, an antibiotic for treating resistant infections. The mango soap exhibits a lower mean of 12.62, failing to meet the average mean and inhibiting Salmonella Typhimurium. In contrast, the pineapple soap shows a higher mean of 14.11, indicating effectiveness against Salmonella Typhimurium compared to the mango soap. In conclusion, pineapple soap exhibits stronger antimicrobial activity against Salmonella Typhimurium than mango soap, but neither completely inhibits the bacterium.

Table 6. Zone of Inhibition of Mango and Pineapple soap formulation against Staphylococcus Aureus

Sample/Control	Staphylococcus Aureus (ATCC 6538) Zone of Inhibition (mm)				
	Replicate 1	Replicate 2	Replicate 3	Mean	SD
Bar Soap with Mango (10mm)	18.73	17.13	18.54	18.13	0.87
Bar Soap with Pineapple (10mm)	19.02	19.65	18.37	19.01	0.64
Positive Control: Oxacillin 1 ug (6mm)	22.27	23.26	23.29	22.94	0.58
Negative Control: Sample-free disc (10mm)	0.00	0.00	0.00	0.00	-

Table 7. Antimicrobial capability of Mango and Pineapple soap formulation against Staphylococcus Aureus

Sample/Control	Staphylococcus aureus (ATCC 6538)		
	Reactivity	Inhibitory Activity	
Bar Soap with Mango (10mm)	3	+++	Susceptible
Bar Soap with Pineapple (10mm)	3	+++	Susceptible
Positive Control: Oxacillin 1 ug (6mm)	4	+++	Susceptible
Negative Control: Sample-free disc (10mm)	0	(-)	Susceptible

Legend: Inhibitory Activity Rating: (+++) Complete; (++) partial; (+) slight, and (-) negative Reactivity Rating: 0 - None (No detectable zone around or under specimen) 1 - Slight (Some malformed or degenerated cells under the specimen) 2 - Mild (Zone limited under the specimen 3 - Moderate (Zone extends 5 to 10 mm beyond specimen) 4 - Severe (Zone extend greater than 10mm beyond specimen)

Table 8. Zone of Inhibition of Mango and Pineapple soap formulation against Salmonella typhimurium

Sample/Control	Salmonella typhimurium (ATCC 14028) Zone of Inhibition (mm)				
	Replicate 1	Replicate 2	Replicate 3	Mean	SD
Bar Soap with Mango (10mm)	12.13	12.57	13.15	12.62	0.51
Bar Soap with Pineapple (10mm)	14.04	14.09	14.21	14.11	0.09
Positive Control: Amikacin 30 ug (6mm)	14.6	14.79	14.42	14.6	0.19
Negative Control: Sample-free disc (10mm)	0.00	0.00	0.00	0.00	-

Table 9. Antimicrobial capability of Mango and Pineapple soap formulation against Salmonella typhimurium

Sample/Control	Salmonella typhimurium (ATCC 14028		
	Reactivity	Inhibitory Activity	
Bar Soap with Mango (10mm)	2	+++	Resistant
Bar Soap with Pineapple (10mm)	2	+++	Resistant
Positive Control: Amikacin 30 ug (6mm)	3	+++	Resistant
Negative Control: Sample-free disc (10mm)	0	(-)	Resistant

Legend: Inhibitory Activity Rating: (+++) Complete; (++) partial; (+) slight, and (-) negative
Reactivity Rating: 0 - None (No detectable zone around or under specimen) 1 - Slight (Some malformed or degenerated cells under the specimen) 2 - Mild (Zone limited under the specimen 3 - Moderate (Zone extends 5 to 10 mm beyond specimen) 4 - Severe (Zone extend greater than 10mm beyond specimen)

Table 10. Comparative Analysis

Test organism	Chi-Square	Sig
E. coli	14.244	0.014*
S. aureus	14.892	0.011*
S. typhi	14.939	0.011*

Legend: *Significant at .05 level

Table 11. Comparative analysis of Mango and Pineapple soap formulation against Escherichia coli

		1	2	3	4
Mango	3	12.5033			
Positive	3	13.0067			
Pineapple	3	13.0933	13.0933		
Resist	3		14		
Inter	3			16	
Susc	3				17

Means for groups in homogeneous subsets are displayed. Values in different columns are significantly different.

Table 9 demonstrates the antimicrobial test results for mango and pineapple bar soaps against Salmonella Typhimurium, a pathogenic bacterium often found in meat products and eggshell membranes, and used cooking oil, making it easily transmissible (Arnedo-Pena et al., 2019). The test indicates that both pineapple and mango sustainable soaps exhibit resistance in inhibiting Salmonella Typhimurium. This resistance may be attributed to the eggshell dehydration process, which was conducted at 70 degrees Celsius, below the recommended temperature range (160-170 degrees Fahrenheit or 71-77 degrees Celsius) at which Salmonella cannot thrive (Wiley & Son, 2018). This suboptimal dehydration temperature potentially affects the soaps' antimicrobial properties since eggshells are included in the formulations for exfoliation and antimicrobial effects. Both variants exhibit a resistance rating of 2, signifying mild resistance to Salmonella Typhimurium as per DOST laboratory tests. Further research is needed to enhance the antibacterial efficacy of these sustainable soaps. The results indicate significant variations in the zone of inhibition for the three tested organisms: E. coli, S. aureus, and S. typhi, across different treatments, including mango bar soap, pineapple bar soap, positive control, and standard zones classified as resistant, intermediate, and susceptible. Table 6, 8, and 10 display these differences, with measurements taken alongside positive and negative controls. The variation in positive controls, Amikacin for Escherichia Coli and Salmonella Typhimurium, and Oxacillin for Staphylococcus Aureus, could contribute to the observed differences. The E. coli test results show significant differences between mango and pineapple soap variants, the positive control, and standard zone of inhibition categories (resistant, intermediate, and susceptible). Mango soap falls short of the standards, while pineapple soap aligns with the resistant standard. Both soaps perform similarly to the positive control, Amikacin. The test results for S. aureus indicate that both mango soap and pineapple soap, along with the positive control (Oxacillin), have significantly larger zones of inhibition compared to the established standards. Moreover, there is no notable difference between the efficacy of mango and pineapple soaps and the positive control. Oxacillin, an effective narrow-spectrum antibiotic for staphylococcal infections, serves as the positive control.

Table 12. Comparative analysis of Mango and Pineapple soap formulation against Staphylococcus Aureus

		1	2
Resist	3	10	
Inter	3	12	
Susc	3	13	
Mango	3		18.13
Pineapple	3		19.01
Positive	3		22.94

Table 13. Comparative analysis of Mango and Pineapple soap formulation against Salmonella typhimurium

		1	2
Mango	3	12.62	
Pineapple	3	14.11	
Positive	3	14.6	
Resist	3	15	
Inter	3		18
Susc	3		19

The S. Typhimurium test results show a significant difference in the zone of inhibition among the test materials, with soap containing mango (μ=13.59), soap with pineapple (μ= 13.82), and the positive control (μ= 13.93) falling below the resistant standard (μ= 15) but exceeding the intermediate (μ= 18) and susceptible (μ=19) classifications.

There's no significant difference between the test materials and the positive control or the resistant classification. The positive control, Amikacin, used for S. Typhimurium, resembles its use in the E. Coli test.

REFERENCES

Abdulazeez 2016. Lemongrass (Cymbopogon): a review on its structure, properties, applications and recent development. Retrieved From April 22, 2023. Lemongrass (Cymbopogon): a review on its structure, properties, applications and recent development

Acebes, R. A. N., Cuento, M. G. R., Serna, A. G. S., Gutierrez, T. A. D., & Papa, D. M. D. (2021). Comparing the Efficacy of Bacteriophages and Antibiotics in Treating Salmonella enterica Serovar Typhimurium on Streptomycin-pretreated Mice Retrieved from: https://agris.fao.org/agris-search/ search.do?recordID=PH2022000803

Adigun, O., Manful, C., Prieto Vidal, N., Mumtaz, A., Pham, T. H., Stewart, P., ... & Thomas, R. (2019). Use of natural antioxidants from newfoundland wild berries to improve the shelf life of natural herbal soaps. Antioxidants, 8(11), 536. Retrieved March 28, 2023, from Antioxidants | Free Full-Text | Use of Natural Antioxidants from Newfoundland Wild Berries to Improve the Shelf Life of Natural Herbal Soaps

Aguja, A. (2020, September 30). 50% of Pinoys don’t know safe handwashing – 2020 Handwashing Habits Survey. Retrieved March 28, 2023 from https://www.philstar.com/ lifestyle/health-and-family/2020/09/30/2046204/50-pinoys-dont-know-safe-handwashing-2020-handwashing-habits-survey

Ahmed, T. A., Kulshreshtha, G., & Hincke, M. T. (2019). Value-added uses of eggshell and eggshell membranes. In Eggs as functional foods and nutraceuticals for human health (pp. 359-397). Retrieved April 14, 2023 from https://books.rsc.org/ books/edited-volume/768/chapter-abstract/494569/Value-added-Uses-of-Eggshell-and-Eggshell?redirectedFrom=fulltext

Ahmed, T. A., Wu, L., Younes, M., & Hincke, M. (2021). Biotechnological applications of eggshell: recent advances. *Frontiers in Bioengineering and Biotechnology*, *9*, 675364. Retrieved April 11, 2023 from https://www. frontiersin.org/articles/10.3389/fbioe.2021.675364/full

Alara, O. R., Abdurahman, N. H., & Ukaegbu, C. I. (2021). Extraction of phenolic compounds: A review. Current Research in Food Science, 4, 200-214. Retrieved March 26, 2023, from Extraction of phenolic compounds: A review - ScienceDirect

Alagumanai, A. (2015). Exploring phytochemical composition, photocatalytic, antibacterial, and antifungal efficacies of Au NPs supported by Cymbopogon flexuosus essential oil Retrieved From April 22, 2023. Exploring phytochemical composition, photocatalytic, antibacterial, and antifungal efficacies of Au NPs supported by Cymbopogon flexuosus essential oil

Alcantara,J. et al, (2022) Soap Zero: ASustainability Effort Through Development of Soap from Food Waste with Physicochemical, Antimicrobial and Consumer Sensory Analysis (Unpublished Thesis). Lyceum of the Philippines University – Laguna

Ali, J., Abbas, S., Khan, F., Rehman, S. U., Shah, J., Rahman, Z. U., ... & Shahid, M. (2016). Biochemical and antimicrobial properties of citrus peel waste. *Pharmacologyonline*, *3*, 98-103. Retrieved April 16, 2023 https://pharmacologyonline.silae.it/ files/archives/2016/vol3/PhOL_2016_3_A015_24_Shahid.pdf

Amicarelli, V., Aluculesei, A. C., Lagioia, G., Pamfilie, R., &Bux, C. (2022). How to manage and minimize food waste in the hotel industry: An exploratory research. International Journal of Culture, Tourism and Hospitality Research, 16(1), 152-167. Retrieved March 11, 2023, from How to manage and minimize food waste in the hotel industry: an exploratory research | Emerald Insight

Ananno, A. A., Masud, M. H., Chowdhury, S. A., Dabnichki, P., Ahmed, N., & Arefin, A. M. E. (2021). Sustainable food waste management model for Bangladesh. Sustainable Production and Consumption, 27, 35-51. Retrieved March 11, 2023, from Sustainable food waste management model for Bangladesh - ScienceDirect

Ananno, A. A., Masud, M. H., Chowdhury, S. A., Dabnichki, P., Ahmed, N., & Arefin, A. M. E. (2021). Sustainable food waste management model for Bangladesh. Sustainable Production and

Consumption, 27, 35-51. Retrieved March 11, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S2352550920313622

Antibiotics, 9(4), 198. Retrieved March 28, 2023 from https://www.mdpi.com/2079-6382/9/4/198

Antonić, B., Dordević, D., Jančíková, S., Tremlova, B., &Kushkevych, I. (2020). Physicochemical characterization of home-made soap from waste-used frying oils. *Processes*, *8*(10), 1219.https://www.mdpi.com/2227-9717/8/10/1219

Arasaretnam, S., &Venujah, K. (2019). Preparation of soaps by using different oil and analyze their properties. Nat Prod Chem Res, 7(357), 2-4. Retrieve August 21 2023 from https://www.researchgate.net/profile/Venujah-Kathiresapillai/publication/369416356_Preparation_of_Soaps_by_Using_Different_Oil_and_Analyze_their_Properties/links/641a94fc315dfb4cce9d704c/Preparation-of-Soaps-by-Using-Different-Oil-and-Analyze-their-Properties.pdf

Arnedo-Pena, A., Vizcaíno-Batllés, A., Ferrer, N. M., & Romeu-Garcia, A. (2019). (PDF) Risk factors of sporadic of Salmonella and Salmonella Typhimurium infections in Castellon (Spain): a matched case-control study.

Article about water, last reviewed august 1, 2023. https://www.cdc.gov/healthywater/drinking/preventing-waterborne-germs-at-home. html#:~:text=Waterborne%20germs%20can%20grow%20in%20pipes,-According%20to%20federal&text=But%20tap%20water%20is%20not,still%20be%20i n%20the%20water.

Azevedo Martins, T. E., Sales de Oliveira Pinto, C. A., Costa de Oliveira, A., Robles Velasco, M. V., Gorriti Guitiérrez, A. R., Cosquillo Rafael, M. F., ... &Retuerto-Figueroa, M. G. (2020). Contribution of topical antioxidants to maintain healthy skin—A review. Scientia Pharmaceutica, 88(2), 27. Retrieved March 28, 2023, from Sci. Pharm. | Free Full-Text | Contribution of Topical Antioxidants to Maintain Healthy Skin—A Review

B. Malorny, et.al, (2016). Salmonella: Salmonellosis. Retrieved March 22, 2023 from https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/salmonella-bongori

Bayot, M. & Bragg B. (2022). Antimicrobial Susceptibility Testing. Retrieved March 28, 2023 from https://www.ncbi.nlm.nih.gov/books/NBK539714/?fbclid=IwAR0ARV46gZ-zysXC0EYd4p6_TLaeHgLJWdh9mnIlFP-sq4uf5y31YX8hcOY#:~:text=Antimicrobial%20susceptibility%20testing%20(AST)%20is,specifically%20effective%20for%20individual%20patients

Bekele (2017). Lemongrass (Cymbopogon): a review on its structure, properties, applications and recent development. Retrieved from April 22, 2023. Lemongrass (Cymbopogon): a review on its structure, properties, applications and recent development

Centers for Disease Control and Prevention. (2018, August 9). Staphylococcal (staph) food

poisoning. Centers for Disease Control and Prevention. Retrieved March 28, 2023, from https://www.cdc.gov/foodsafety/diseases/staphylococcal.html

Centers for Disease Control and Prevention. (2022, July 6). Food worker handwashing in restaurants. Centers for Disease Control and Prevention. Retrieved March 28, 2023, from https://www.cdc.gov/nceh/ehs/ehsnet/plain_language/food-worker-handwashing-in-restaurants.html

Chams, N., & García-Blandón, J. (2019). On the importance of sustainable human resource management for the adoption of sustainable development goals. Resources, Conservation and Recycling, 141, 109-122. https://www.sciencedirect.com/science/article/abs/pii/S0921344918303719

Chaudhary, V., Kumar, V., Singh, K., Kumar, R., & Kumar, V. (2019). Pineapple (Ananas cosmosus) product processing: A review. Journal of pharmacognosy and Phytochemistry, 8(3), 4642-4652. Retrieved March 25, 2023, from Pineapple (Ananas cosmosus) product processing: A review

Chukwuocha U.M (2016) Biosynthesis of Silver Nanoparticles from Cymbopogon citratus Leaf Extract and Evaluation of Their Antimicrobial Activities. Retrieved from April 22, 2023. Biosynthesis of Silver Nanoparticles from Cymbopogon citratus Leaf Extract and Evaluation of Their Antimicrobial Activities

Cos, W. (2022, October 5). Tons of food wasted as millions of Filipinos go hungry. ABS. Retrieved March 14,2023 from https://news.abs-cbn.com/news/10/04/22/tons-of-food-wasted-as-millions-of-filipinos-go-hungry

Crebello, R. L., &Somoray, M. J. M. (2019). Pontential Germicidal Soap of Mangifera Indica Linn.(Mango) Fruit Peel Extract. Retrieved March 26, 2023, from 111_Pontential_Germicidal_Soap_of_Mangifera_Indica_Linn._Mango__Fruit_Feel_Extract20190606-33121-v431vi-libre.pdf

De Lima Cherubim, D. J., Buzanello Martins, C. V., Oliveira Fariña, L., & da Silva de Lucca, R. A. (2020). Polyphenols as natural antioxidants in cosmetics applications. Journal of cosmetic dermatology, 19(1), 33-37. Retrieved March 26, 2023, from Polyphenols as natural antioxidants in cosmetics applications - Cherubim - 2020 - Journal of Cosmetic Dermatology - Wiley Online Library

Dela Peña, K. (2021, October 22). The malady of food waste: Millions starve as trash bins fill with leftovers. Retrieved March 14, 2023 from https://newsinfo.inquirer.net/1505252/the-malady-of-food-waste-millions-starve-as-trash-bins-fill-with-leftovers?fbclid=IwAR3p4yVxLWXDzpPUw8kNKFiXIuxH7Bd1nPPwJNDQ_bKyslWsKCQiPxFsz-k

Dema, N., & Subba, J. R. (2022). Physiochemical Properties of the Commercial Herbal Soaps of Bhutan. SherubDoenme: The Research Journal of Sherubtse College, 15(1).

Department of Agriculture, (2018). Philippine Mango Industry Roadmap (2017-2022). Retrieved August 30,2023 from https://www.da.gov.ph/wp-content/uploads/2019/06/Philippine-Mango-Industry-Roadmap-2017-2022.pdf

Dias, M. C., Pinto, D. C., & Silva, A. M. (2021). Plant flavonoids: Chemical characteristics and biological activity. Molecules, 26(17), 5377. Retrieved March 28, 2023, from Molecules | Free Full-Text | Plant Flavonoids: Chemical Characteristics and Biological Activity

Dias, R., Oliveira, H., Fernandes, I., Simal-Gandara, J., & Perez-Gregorio, R. (2021). Recent advances in extracting phenolic compounds from food and their use in disease prevention and as cosmetics. Critical reviews in food science and nutrition, 61(7), 1130-1151. Retrieved March 26, 2023, from Recent advances in extracting phenolic compounds from food and their use in disease prevention and as cosmetics: Critical Reviews in Food Science and Nutrition: Vol 61, No 7

Erlita, Krismaya, Nurani, Sopianti (2017). Effectiveness Bleaching of Waste Cooking Oil Cleaning using nano-montmorillonite adsorbent. Retrieved from April 24, 2023. Effectiveness Bleaching of Waste Cooking Oil Cleaning using nano-montmorillonite adsorbent.

Espinosa-Espinosa, L., Garduño-Siciliano, L., Rodriguez-Canales, M., Hernandez-Portilla, L. B., Canales-Martinez, M. M., &Rodriguez-Monroy, M. A. (2022). The wound-healing effect of mango peel extract on incision wounds in a murine model. Molecules, 27(1), 259. Retrieved March 26, 2023, from Molecules | Free Full-Text | The Wound-Healing Effect of Mango Peel Extract on Incision Wounds in a Murine Model

Felix (2017). Recycling waste cooking oil into soap: knowledge transfer through community service learning. Retrieved from April 23, 2023. Recycling waste cooking oil into soap: knowledge transfer through community service learning

Filimonau, V., & De Coteau, D. A. (2019). Food waste management in hospitality operations: A critical review. Tourism management, 71, 234-245. Retrieved March 11, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0261517718302449

Fitriani, Dian. "Karakteristik Dan Aktivitas Antifungi Sabun Padat Transparan Dengan Bahan Aktif Ekstrak Daun Buas-buas (Premna Cordifolia, Linn)." *Enviroscienteae*, vol. 13, no. 1, Apr. 2017, pp. 40-46. https://www.neliti.com/publications/278897/karakteristik-dan-aktivitas-antifungi-sabun-padat-transparan-dengan-bahan-aktif#cite

Food Safety and Inspection Services (2017). Salmonella Questions and Answers. Retrieved March 22, 2023 from https://www.fsis.usda.gov/food-safety/foodborne-illness-and-disease/illnesses-and-pathogens/salmonella-questions-and-answers

González-Miquel, M., & Díaz, I. (2020). Valorization of citrus waste through sustainable extraction processes. In *Food industry wastes* (pp. 113-133). Academic Press. Retrieved April 15, 2023 from https://www.sciencedirect.com/science/article/pii/B9780128171219000061

Güzel, M., & Akpınar, Ö. (2019). Valorisation of fruit by-products: Production characterization of pectins from fruit peels. Food and Bioproducts Processing, 115, 126-133. Retrieved March 25, 2023, from Sci-Hub | Valorisation of fruit by-products: Production characterization of pectins from fruit peels. Food and Bioproducts Processing, 115, 126–133 | 10.1016/j.fbp.2019.03.009

Idoko, O., Emmanuel, S. A., Salau, A. A., &Obigwa, P. A. (2018). Quality assessment on some soaps sold in Nigeria. Nigerian Journal of Technology, 37(4), 1137-1140 Retrieve August 21 2023 from https://www.ajol.info/index.php/njt/article/view/179743

Hatem, S., Nasr, M., Elkheshen, S. A., &Geneidi, A. S. (2018). Recent advances in antioxidant cosmeceutical topical delivery. Current Drug Delivery, 15(7), 953-964. Retrieved March 28, 2023 Recent Advances in Antioxidant Cosmeceutical Topical Delivery: Ingenta Connect

Heikkilä, L., Reinikainen, A., Katajajuuri, J. M., Silvennoinen, K., & Hartikainen, H. (2016). Elements affecting food waste in the food service sector. Waste Management, 56, 446-453. Retrieved March 11, 2023, from Elements affecting food waste in the food service sector - ScienceDirect

Hernández-Carranza, P., Ávila-Sosa, R., Guerrero-Beltrán, J. A., Navarro-Cruz, A. R., Corona-Jiménez, E., & Ochoa-Velasco, C. E. (2016). Optimization of antioxidant compounds extraction from fruit by-products: Apple pomace, orange and banana peel. Journal of food processing and preservation, 40(1), 103-115. Retrieved March 28, 2023, from Optimization of Antioxidant Compounds Extraction from Fruit By-Products: Apple Pomace, Orange and Banana Peel –

Hudzicki, J. (2009). Kirby-Bauer disk diffusion susceptibility test protocol. *American society for microbiology*, *15*, 55-63

Hryniewicz, M. M., & Garbacz, K. (2017). Borderline oxacillin-resistant Staphylococcus aureus (BORSA)–a more common problem than expected?. *Journal of medical microbiology*, *66*(10), 1367-1373. Retrieve August 21 2023 from https://www.microbiologyresearch.org/content/journal/jmm/10.1099/j mm.0.000585

Hussain, T., Tan, B., Yin, Y., Blachier, F., Tossou, M. C., & Rahu, N. (2016). Oxidative stress and inflammation: what polyphenols can do for us?. Oxidative medicine and cellular longevity, 2016. Retrieved March 26, 2023, from Oxidative Stress and Inflammation: What Polyphenols Can Do for Us?

Idoko, O., Emmanuel, S. A., Salau, A. A., &Obigwa, P. A. (2018). Quality assessment on some soaps sold in Nigeria. Nigerian Journal of Technology, 37(4), 1137- 1140 Retrieve August 21 2023 from https://www.ajol.info/index.php/njt/article/view/179743

John Wiley & Sons. (2018). Professional cooking, https://books.google.com.ph/books?id=VfpVEAAAQBAJ&dq=standard+cooking+temp+in+kitchen+killing+bacteria+&lr=&source=gbs_navlinks_s

Jose, R., & Ramakrishna, S. (2021). Comprehensiveness in the Research on Sustainability. Materials Circular Economy, 3, 1-2.https://link.springer.com/article/10.1007/s42824-020-00015-x

J. Thorpe (2018). Waste Vegetable Oil Properties with Usage and its Impact on artis Retrieved From April 22, 2023. Waste Vegetable Oil Properties with Usage and its Impact on artis

Kasavan, S., Mohamed, A. F., & Halim, S. A. (2017). Sustainable food waste management in hotels: case study Langkawi Unesco Global Geopark. Planning Malaysia, 15. Retrieved March 11, 2023, from SUSTAINABLE FOOD WASTE MANAGEMENT IN HOTELS: CASE STUDY LANGKAWI UNESCO GLOBAL GEOPARK | PLANNING MALAYSIA

Kilibarda, N., Djokovic, F., &Suzic, R. (2019). Food waste management–reducing and managing food waste in hospitality. Scientific journal" Meat Technology", 60(2), 134-142. Retrieved March 11, 2023, from Food waste management – reducing and managing food waste in hospitality | Scientific journal "Meat Technology"

Klibenstein M. (2020) Antifungal Antioxidant and Antibiofilm Activities of Essential Oils of Cymbopogon spp. Retrieved from April 23, 2023 Antifungal Antioxidant and Antibiofilm Activities of Essential Oils of Cymbopogon spp.

Kulshreshtha, G., Diep, T., Hudson, H. A., & Hincke, M. T. (2022). High value applications and current commercial market for eggshell membranes and derived bioactives. *Food Chemistry*, 132270. Retrieved April 11, 2023 from https://www.sciencedirect.com/science/article/abs/pii/S030881462200231X

Lademann, J., Vergou, T., Darvin, M. E., Patzelt, A., Meinke, M. C., Voit, C., ... & Doucet, O. (2016). Influence of topical, systemic and combined application of antioxidants on the barrier properties of the human skin. Skin pharmacology and physiology, 29(1), 41-46. Retrieved March 28, 2023, from Influence of Topical, Systemic and Combined Application of Antioxidants on the Barrier Properties of the Human Skin - Abstract - Skin Pharmacology and Physiology 2016, Vol. 29, No. 1 - Karger Publishers

Legrand, W., Chen, J. S., &Laeis, G. C. (2022). Sustainability in the hospitality industry: Principles of sustainable operations. Taylor & Francis. Retrieved March 11, 2023 from https://books.google.com.ph/books?hl=en&lr=&id=NWJ6EAAAQBAJ&oi=fnd&pg=PT19&dq=sustainability+in+hospitality+industry&ots=bfGZfmsRX_&sig=rCeZZP0V-2As421pS3sSsgXtNbg&redir_esc=y#v=onepage&q&f=false

Madhumeena, S., Preetha, R., & Prasad, S. (2021, August). Effective utilization of pineapple waste. In Journal of Physics: Conference Series (Vol. 1979, No. 1, p. 012001). IOP Publishing. Retrieved March 25, 2023, from Effective Utilization of Pineapple Waste - IOPscienc

Martin-Rios, C., Demen-Meier, C., Gössling, S., &Cornuz, C. (2018). Food waste management innovations in the foodservice industry. Waste management, 79, 196-206. Retrieved March 11, 2023, from Food waste management innovations in the foodservice industry - ScienceDirect

Marimuthu, C., Chandrasekar, P., Murugan, J., Perumal, K., Marimuthu, I., Sukumar, S., & Ravichandran, S. (2020). Application and merits of Eggshell Membrane in Cosmetics. *Research Journal of Topical and Cosmetic Sciences*, *11*(1), 24-31. Retrieved April 14, 2023 from https://www.indianjournals.com/ijor.aspx?target=ijor:rjtcs&volume=11&issue=1&article=006

Maria, A. (2017). Soap production: A green prospective. *Waste management*. Retrieved April 16, 2023https://agris.fao.org/agris-search/search.do?recordID=US201700236576

Mayo Clinic, (2021). E. coli Retrieved March 22, 2023, from.https://www.mayoclinic.org/diseases-conditions/e-coli/symptoms-causes/syc-20372058#:~:text=You%20may%20be%20exposed%20to,threatening%20form%20of%20kidney%20failure.

Lisa Adhani (2016) Making biodiesel by adsorption and transesterification from used cooking oil. Retrieved from April 24, 2023. Making biodiesel by adsorption and transesterification from used cooking oil.

Lubaina, A. S., Renjith, P. R., & Kumar, P. (2019). Antibacterial potential of different extracts of pineapple peel against gram-positive and gram-negative bacterial strains. Asian Journal of Pharmacy and Pharmacology, 5(S1), 66-70. Retrieved March 25, 2023, from Antibacterial potential of di…

Macedo, A., Gomes, T., Ribeiro, C., Moldão-Martins, M., Duarte, E., & Alves, V. D. (2022). Membrane technology for valorization of mango peel extracts. *Foods*, *11*(17), 2581.
https://www.mdpi.com/2304-8158/11/17/2581

Maotsela(2019). Recycling waste cooking oil into soap: knowledge transfer through community service learning. Retrieved from April 23, 2023. Recycling waste cooking oil into soap: knowledge transfer through community service learning.

Mardiah& Darwis, Sopianti, Alamsyah, Santriwati, Sinurat and Ramlan, Muhammad (2019) Effectiveness Bleaching of Waste Cooking Oil Cleaning using nano-montmorillonite adsorbent. Retrieved from April 24, 2023. Effectiveness Bleaching of Waste Cooking Oil Cleaning using nano-montmorillonite adsorbent.

M'hiri, N., Ioannou, I., Ghoul, M., & Mihoubi Boudhrioua, N. (2017). Phytochemical characteristics of citrus peel and effect of conventional and nonconventional processing on phenolic compounds: A review. Food Reviews International, 33(6), 587-619. Retrieved March 28, 2023, from Phytochemical characteristics of citrus peel and effect of conventional and nonconventional processing on phenolic compounds: A review: Food Reviews International: Vol 33, No 6

Mikhaylov, A., Moiseev, N., Aleshin, K., & Burkhardt, T. (2020). Global climate change and greenhouse effect. Entrepreneurship and Sustainability Issues, 7(4), 2897. https://www.researchgate.net/profile/Alexey-Mikhaylov/publication/342372335_Global_climate_change_and_greenhouse_effect/links/5f576af2299bf13a31ab136c/Global-climate-change-and-greenhouse-effect.pdf

National Library of Medicine. (2021) Effect of Microbial Quality of Washing Water on Hand Hygiene Status of Food Handlers in Jimma Town: Implication for Food Hygiene and Safety Retrieved March 28, 2023 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8141394/

Nordin, N. L., Sulaiman, R., Bakar, J., &Noranizan, M. A. (2023). Comparison of Phenolic and Volatile Compounds in MD2 Pineapple Peel and Core. *Foods*, *12*(11), 2233. https://www.mdpi.com/2304-8158/12/11/2233#B52-foods-12-02233 (nordin,2023)

Oliver-Simancas, R., Labrador-Fernandez, L., Díaz-Maroto, M. C., Pérez-Coello, M. S., &Alañón, M. E. (2021). Comprehensive research on mango by-products applications in food industry. Trends in Food Science & Technology, 118, 179-188. Retrieved March 26, 2023, from Comprehensive research on mango by-products applications in food industry - ScienceDirect

Oliver-Simancas, R., Muñoz, R., Díaz-Maroto, M. C., Pérez-Coello, M. S., &Alañón, M. E. (2020). Mango by-products as a natural source of valuable odor-active compounds. Journal of the Science of Food and Agriculture, 100(13), 4688-4695. Retrieved March 26, 2023, from Mango by-products as a natural source of valuable odor-active compounds - Oliver-Simancas - 2020 - Journal of the Science of Food and Agriculture - Wiley Online Library

Olszowy, M. (2019). What is responsible for antioxidant properties of polyphenolic compounds from plants?. Plant Physiology and Biochemistry, 144, 135-143. Retrieved March 26, 2023, from What is responsible for antioxidant properties of polyphenolic compounds from plants? - ScienceDirect

Ondusko, D. S., & Nolt, D. (2018, June 1). Staphylococcus aureus . Publications.aap.org. Retrieved March 22, 2023, from https://publications.aap.org/pediatricsinreview/article-abstract/39/6/287/35183/Staphylococcus-aureus

Panche, A. N., Diwan, A. D., & Chandra, S. R. (2016). Flavonoids: an overview. Journal of nutritional science, 5, e47. Retrieved March 28, 2023, from Flavonoids: an overview | Journal of Nutritional Science | Cambridge Core

Panther, D. J., & Jacob, S. E. (2015). The importance of acidification in atopic eczema: an underexplored avenue for treatment. *Journal of clinical medicine*, *4*(5), 970-978.
https://www.mdpi.com/2077-0383/4/5/970#B38-jcm-04-00970

Patricia, M., Azanza, V., Niño, B., Membrebe, Q., Grace, R., Sanchez, R., Estilo, E. C., Grace, U., Dollete, M., Feliciano, R. J., Kristel, N., & Garcia, A. (2019). Foodborne Disease Outbreaks in the Philippines (2005-2018). Philippine Journal of Science, 148(2), 317–336.

Philippine Red Cross. (2022, November 19). The Philippine Red Cross celebrates World Toilet Day 2022!. Retrieved March 28, 2023, from https://redcross.org.ph/tag/handwashing/?fbclid=IwAR313m3xTsu0TxjCq2CPr6nKiirTEk6AgV1G2FuVglIWxRtZJiCKxhdh3zo

Philippine Statistics Authority, (2022). 2022 Selected Statistics on Agriculture and Fisheries. Retrieved August 30, 2023 from https://www.psa.gov.ph/system/files/main-publication/%2528ons-cleared%2529_SSAF%25202022%2520as%2520of%252030082022_ONS-signed.pdf

Pineapple: Philippine Statistics Authority: Republic of the Philippines. Philippine Statistics Authority. (2023). https://www.psa.gov.ph/major-fruit-crops/pineapple?fbclid=IwAR3mFNVdFKvfVOit2jAcWQ7enWNn2-G3gPkfQwgG4Mk9IACv9mdIRvUaKxM

Poirel, L., Madec, J. Y., Lupo, A., Schink, A. K., Kieffer, N., Nordmann, P., & Schwarz, S. (2018). Antimicrobial resistance in Escherichia coli. Microbiology Spectrum, 6(4), 6-4. Retrieved March 22, 2023 from https://journals.asm.org/doi/full/10.1128/microbiolspec.ARBA-0026-2017

PRDP I-PLAN presents Pineapple VCA to Laguna stakeholders. Philippine Rural Development Project. (2020, July 14). http://prdp.da.gov.ph/prdp-i-plan-presents-pineapple-vca-to-laguna-stakeholders/?fbclid=IwAR1L2T3uH9gtPlOno_9XFsmWvoSSSiM6EbVrm7FEG7wTFhMCZyhslDkgNfY

Punbasayakul, N., Samart, K., &Sudmee, W. (2018, January). Antimicrobial activity of pineapple peel extract. In Proceeding of Innovation of Functional Foods in Asia Conference. https://scholar.google.com/scholar_lookup?title=Antimicrobial+activity+of+pineapple+peel+extract&conference=Proceedings+of+the+Innovation+of+Functional+Foods+in+Asia+Conference&author=Punbusayakul,+N.&author=Samart,+S.&author=Sudmee,+W.&publication_year=2018

Purwati, E., &Raharjeng, S. W. (2023). AKTIVITAS ANTIBAKTERI SABUN PADAT EKSTRAK KULIT BUAH NANAS (Ananas comosus L.) PADA Escherichia coli. Jurnal Ilmiah Manuntung, 9(1), 71-78. http://jurnal.stiksam.ac.id/index.php/jim/article/view/670

Ramadani, A. H., Karima, R., & Ningrum, R. S. (2022). Antibacterial Activity of Pineapple Peel (Ananas comosus) Eco-enzyme Against Acne Bacterias (Staphylococcus aureus and Prapionibacterium acnes). Indonesian Journal of Chemical Research, 9(3), 201-207. Retrieved March 25, 2023, from Antibacterial Activity of Pineapple Peel (Ananas comosus) Eco-enzyme Against Acne Bacterias (Staphylococcus aureus and Prapionibacterium acnes) | Indonesian Journal of Chemical Research

Rambabu, K., Edathil, A. A., Nirmala, G. S., Hasan, S. W., Yousef, A. F., Show, P. L., & Banat, F. (2020). Date-fruit syrup waste extract as a natural additive for soap production with enhanced antioxidant and antibacterial activity. Environmental Technology & Innovation, 20, 101153. Retrieved March 28, 2023, from Date-fruit syrup waste extract as a natural additive for soap production with enhanced antioxidant and antibacterial activity - ScienceDirect

Ramirez, M. S., &Tolmasky, M. E. (2017). Amikacin: uses, resistance, and prospects for inhibition. *Molecules*, *22*(12), 2267.https://www.mdpi.com/1420-3049/22/12/ 2267

Riley, L. W. (2020). Distinguishing pathovars from nonpathovars: Escherichia coli. Microbiology Spectrum, 8(4), 8-4. https://journals.asm.org/doi/full/10.1128/microbiolspec.AME-0014-2020

Saleem, M., & Saeed, M. T. (2020). Potential application of waste fruit peels (orange, yellow lemon and banana) as wide range natural antimicrobial agent. *Journal of King Saud University-Science*, *32*(1), 805-810. Retrieved April 16, 2023 https://www.sciencedirect.com/science/article/pii/S1018364718308504

Samarakoon, S. M. G. K., & Rajapakse, C. S. K. (2022). Peel of pineapple (Ananas comosus) as a potential source of antioxidants and photo-protective agents for sun protection cosmetics. Medicinal Plants-International Journal of Phytomedicines and Related Industries, 14(1), 95-104. Retrieved March 25, 2023, from https://www.indianjournals.com/ijor.aspx?target=ijor:mpijpri&volume=14&issue=1&article=010

Saraswaty, V., Risdian, C., Primadona, I., Andriyani, R., Andayani, D. G. S., &Mozef, T. (2017, March). Pineapple peel wastes as a potential source of antioxidant compounds. In IOP conference series: earth and environmental science (Vol. 60, No. 1, p.

012013). IOP Publishing. Retrieved March 25, 2023, from Pineapple peel wastes as a potential source of antioxidant compounds – IOPscience

Scudiero, O., Brancaccio, M., Mennitti, C., Laneri, S., Lombardo, B., De Biasi, M. G., De Gregorio, E., Pagliuca, C., Colicchio, R., & Salvatore, P. (2020). Human defensins: A novel approach in the fight against skin colonizing staphylococcus aureus.

Sharma, P., Vishvakarma, R., Gautam, K., Vimal, A., Gaur, V. K., Farooqui, A., ... & Younis, K. (2022). Valorization of citruspeel waste for the sustainable production of value-added products. *Bioresource Technology*, 127064. Retrieved April 15, 2023 from https://www.sciencedirect.com/science/article/abs/pii/S0960852422003935

Sia, S. (2020) .A Fifteen-year Report of Serotype Distribution and Antimicrobial Resistance of Salmonella in the Philippines. Retrieved March 22, 2023 from Staph food poisoning. PeaceHealth. (2022, October 31). Retrieved March 28, 2023, from https://www.peacehealth.org/medical-topics/id/te6322spec

Staph food poisoning. PeaceHealth. (2022, October 31). Retrieved March 28, 2023, from https://www.peacehealth.org/medical-topics/id/te6322spec

Stephane F.Y.Y (2020) Antifungal Antioxidant and Antibiofilm Activities of Essential Oils of Cymbopogon spp. Retrieved from April 23, 2023 Antifungal Antioxidant and Antibiofilm Activities of Essential Oils of Cymbopogon spp.

Sukeksi, L., & Diana, V. (2020, May). Preparation and characterization of coconut oil based soap with kaolin as filler. In *Journal of Physics: Conference Series* (Vol. 1542, No. 1, p. 012046). IOP Publishing. https://iopscience.iop.org/article/10.1088/1742-6596/1542/1/012046/pdf (sukeksi,2020)

Sukeksi, L., Diana, V., &Iriany M. G., (2020, June). Characterization of the Chemical and Physical Properties of Bar Soap Made with Different Concentrations of Bentonite as a Filler. Form file:///C:/Users/joselito/Downloads/IJTech_CE-4130_Characterization-of-the-Chemical-and-Physical-Prop.pdf

Suri, S., Singh, A., & Nema, P. K. (2021). Recent advances in valorization of citrus fruits processing waste: a way forward towards environmental sustainability. *Food Science and Biotechnology*, 1-26. Retrieved April 14, 2023 from https://link.springer.com/article/10.1007/s10068-021-00984-y

Suryani, S., Sariani, S., Earnestly, F., Marganof, M., Rahmawati, R., Sevindrajuta, S., ... & Fudholi, A. (2020). A comparative study of virgin coconut oil, coconut oil and palm ` oil in terms of their active ingredients. *Processes*, *8*(4), 402. https://www.mdpi.com/2227-9717/8/4/402

Taylor, T. A., &Unakal, C. G. (2022, July 18). NCBI Bookshelf. Retrieved March 22, 2023, from https://www.ncbi.nlm.nih.gov/books/NBK441868/

Testing. (2020). Antibiotic Susceptibility Testing. Retrieved March 28, 2023 from https://www.testing.com/tests/antibiotic-susceptibility-testing/

Torres-León, C., de Azevedo Ramos, B., dos Santos Correia, M. T., Carneiro-da-Cunha, M. G., Ramirez-Guzman, N., Alves, L. C., ... & Aguilar, C. N. (2021). Antioxidant and anti-staphylococcal activity of polyphenolic-rich extracts from Ataulfo mango seed. LWT, 148, 111653. Retrieved March 26, 2023, from Antioxidant and anti-staphylococcal activity of polyphenolic-rich extracts from Ataulfo mango seed - ScienceDirect

Vandeginste, V. (2021). Food waste eggshell valorization through development of new composites: A review. Sustainable Materials and Technologies, 29, e00317. Retrieved April 11, 2023 from https://www.sciencedirect.com/science/article/abs/pii/S2214993721000725

Viktorova(2020). Antimicrobial activity of citronella (Cymbopogon citratus) essential oil separation by ultrasound assisted ohmic heating hydrodistillation Retrieved From April 22, 2023. Antimicrobial activity of citronella (Cymbopogon citratus) essential oil separation by ultrasound assisted ohmic heating hydrodistillation

Wadhwa, M., Bakshi, M. P. S., & Makkar, H. P. S. (2016). Wastes to worth: value added products from fruit and vegetable wastes. CABI Reviews, (2015), 1-25. Retrieved March 26, 2023, from Wastes to worth: value added products from fruit and vegetable wastes. | CABI Reviews

Wang, J., Wang, S., Sun, Y., Li, C., Li, Y., Zhang, Q., & Wu, Z. (2019). Reduction of Escherichia coli O157: H7 and naturally present microbes on fresh-cut lettuce using lactic acid and aqueous ozone. *RSC advances*, *9*(39), 22636-22643. https://pubs.rsc.org/en/content/articlehtml/2019/ra/c9ra03544c

Wifek, M., Saeed, A., Rehman, R., & Nisar, S. (2016). Lemongrass: a review on its botany, properties, applications and active components. International Journal of Chemical and Biochemical Sciences, 9(1), 79-84.

World Health Organization. (2018).Salmonella (non-typhoidal). Retrieved March 22, 2023 from https://www.who.int/news-room/fact-sheets/detail/salmonella-(non-typhoidal)

Xing, Y., Liao, X., Liu, X., Li, W., Huang, R., Tang, J., ... & Yu, J. (2021). Characterization and antimicrobial activity of silver nanoparticles synthesized with the peel extract of mango. Materials, 14(19), 5878. Retrieved March 26, 2023, from Materials | Free Full-Text | Characterization and Antimicrobial Activity of Silver Nanoparticles Synthesized with the Peel Extract of Mango

Yadav, D., & Singh, S. P. (2017). Mango: History origin and distribution. Journal of Pharmacognosy and Phytochemistry, 6(6), 1257-1262. Retrieved March 26, 2023, from Mango: History origin and distribution.

****