Research Article

Functional Groups' Characterization of Oil from *Baeckea Frutescens* using Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy (ATR-FTIR)

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Abstract: *Soap is a fatty acid salt found in a variety of cleaning and lubricating products. Soaps are surfactants that are commonly used in the home for washing, bathing, and other household tasks. Palm oil is used in most bar soaps. Unfortunately, over time, palm oil may scarce as one of Malaysia's natural resources. Thus, the goal of this study is to replace palm oil in soap production with wild herbs oil, specifically Baeckea frutescens, which is used in natural remedies to treat a variety of health conditions, such as fever and sunstroke. In this research, the oil from Baeckea frutescens was extracted for soap-making process (saponification). After that, the soap was analysed and characterized using Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy (ATR-FTIR). The ATR-FTIR spectrum could validate the presence of antioxidant compounds such as phenolic acid and flavonoids, which could be beneficial to a health and beauty regimen. The soap was designed in the shape of a small ball to prevent bacteria from spreading through repeated use of the soap. This soap may have benefits for the skin, including anti-inflammatory and antimicrobial properties. In addition, it may be effective in treating skin conditions such as eczema and acne. With its natural ingredients and therapeutic properties, Baeckea frutescens soap may become popular as a natural alternative to commercial soaps.*

Keywords: Baeckea frutescens; saponification; antioxidant compounds.

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1. INTRODUCTION

Soap has been an essential part of human hygiene for thousands of years. It was first introduced by the ancient Babylonians, who discovered that mixing fats with wood ash created a substance that could be used to clean the body (Gibbs, 1939). Soap is made by combining fatty acids with alkaline, such as potassium hydroxide, to create a chemical reaction known as saponification. Soap is now available in a variety of forms and fragrances and served significant purposes such as cleanliness, hygiene, and skincare. Its popularity is growing as people place a higher value on personal hygiene and cleanliness.

Palm oil is a common ingredient in soap due to its elevated level of saturated fat, which makes it an effective emulsifier and moisturizer. However, due to the environmental impact of palm oil plantations, the use of palm oil in soap production has come under scrutiny in recent years. Palm oil production is linked to deforestation, habitat destruction, and biodiversity loss (Lieke et al., 2023). As a

result, soap manufacturers are beginning to explore alternative ingredients in order to create more sustainable and environmentally friendly products.

The goal of this research is to replace palm oil in soap production with oil extracted from wild herbs, specifically *Baeckea frutescens. Baeckea frutescens*, also known as the common heath-leaved myrtle or the native willow, a plant species that is native to Southeast Asia and Australia. It belongs to the family Myrtaceae and has small white flowers that has citrusy aroma, pointed leaves and woody capsules that contain numerous tiny seeds. It is an evergreen shrub that can grow up to two meters tall and has small, round leaves that are aromatic when crushed (Razmavar et al., 2014). *Baeckea frutescens* is valued for its medicinal properties and is used in traditional medicine to treat a range of ailments, including coughs, colds, and skin infections. Its oil is popular in many natural remedies due to its antibacterial, antifungal, and anti-inflammatory properties. According to research by Kamarazaman et al. (2022), *Baeckea frutescens* may be useful in treating a variety of medical conditions, including skin infections. This demonstrates that it is suitable for soap production.

For this research, *Baeckea frutescens* will be obtained from the recreational area of Kolej GENIUS Insan, Universiti Sains Islam Malaysia. The oil from the sample will be extracted, analysed, and made into a single use soap. This project is expected to help travellers maintain their hygiene while on the road by using *Baeckea Frutescens* travel small ball soaps. Given the current global pandemic phenomenon, personal hygiene is one of the most important habits to prevent the spread of diseases. The development of portable, single-use antimicrobial soap will improve hand washing practices and public awareness on the importance of hygiene.

2. METHOD & MATERIAL

2.1 Sample collection

Baeckea frutescens was discovered at Kolej GENIUS Insan, Universiti Sains Islam Malaysia recreational area. The sample was dried at 60°C for 48 hours as the sample's moisture content could obstruct precise measurements and analysis. Additionally, drying process aids in keeping the sample's structure and integrity intact and preventing decomposition. After that, the dried *Baeckea frutescens* was ground with a mechanical grinder to increase the total surface area of sample for oil extraction.

2.2 Solid-liquid extraction

The sample was extracted with ethyl acetate solvent at room temperature to extract important compounds or active compounds that may be trapped within the plant tissue, such as oils, pigments, or phytochemicals. The extracted sample was filtered using Whatman filter paper, No.1 to separate the solute from the solvent. Rotary evaporator is used to remove the remaining solvent and to increase the concentration of analyte for Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy (ATR-FTIR) analysis.

2.3 Saponification method

Saponification is a chemical reaction that occurs between fats and alkalis to produce soap. By mixing 50 cm^3 of 5 mol dm^{-3} sodium hydroxide solution with *Baeckea frutescence*'s oil, an salt solution was created. The mixture was heated to 100°C and stirred continuously until the oil layer vanished.

Next, 50 cm^3 of distilled water and three spatula of sodium chloride were added to the salt solution and boiled for 10 minutes to precipitate the mixtures. To remove any remaining salt and alkali from soap, the mixture was further purified using Ultrapure water and filtered through filter paper. The soap was further dried and rolled-on to form a small ball shape.

3. FINDINGS



Figure 1. FTIR spectral of *Baeckea frutescens*

Table 1. Wavelength and functional group

Wavelength (cm^{-1})	Functional group
3308.23	O-H group
2923.04	C-H stretch
1720.39	C=O aldehyde
1609.12	C=C aromatic
1448.62	C=C aromatic
1313.80	C-O stretch

Fourier Transform Infrared Spectroscopy is a notable and exceptional technique for quantitative and qualitative chemical investigations. The key advantages of FTIR spectroscopy over non-conventional and other analytical procedures include accuracy, quick identification, simplicity, low acquisition financial cost, non-destructive, non-burdening, and minimal to low sample preparation (Gomathi et al., 2014). The spectrum of *Baeckea frutescens* in Figure 1 shows the presence of O-H (3308.23 cm-1) and C-H stretch (2923.04 cm-1). C=O (1720.40 cm-1), C-O (1313.80 cm-1), and C=C aromatic (1609.12 cm-1 and 1448.62 cm-1) are the three most common types of carbon atoms.

4. DISCUSSION

Antioxidants flavonoids and phenolic acids are present in the oil. Flavonoids and phenolic acids are two classes of compounds that are commonly found in plants. They have significant biological activity, including antioxidant and anti-inflammatory effects, and are thus of great interest to the pharmaceutical.

Flavonoids are phytochemicals that offer numerous health benefits. In addition to lowering inflammation and enhancing blood vessel function, they also guard against heart disease and some forms of cancer. Flavonoids have been demonstrated to enhance cognitive function and lower the risk of age-related memory decline in addition to their antioxidant properties (Vauzour et al., 2014).

Flavonoids and phenolic acids are a class of chemicals that are closely related. Similar to flavonoids, phenolic acids are plant-based substances with anti-inflammatory and antioxidant properties. According to data from clinical studies, phenolic acids may help lower the risk of developing chronic illnesses like particular types of cancer, type 2 diabetes, and cardiovascular disease. Additionally, it has been demonstrated that phenolic acids improve gut health by encouraging the development of beneficial bacteria in the intestines (Hidalgo et al., 2012).

5. CONCLUSION

This finding indicated the presence of antioxidant compounds such as phenolic acid and flavonoids, which can benefit a healthy and attractive lifestyle. Since this oil contains skin-friendly antioxidants, it can be used commercially to make soap. In order to stop the spread of germs, the soap was made in the shape of a tiny ball.

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References

Dai, D.N., Thang, T.D., Olayiwola, T.O., Ogunwande, I.A., (2015). Chemical composition of essential oil of Baeckea frutescens L. *International Research Journal of Pure and Applied Chemistry*, 8(1):26-32.

Gibbs, F. W. (1939). The history of the manufacture of soap. *Annals of Science*, 4(2), 169–190. https://doi.org/10.1080/00033793900201191

Gomathi, D., Ravikumar, G., Kalaiselvi, M., Devaki, K., & Uma, C. (2014). Antioxidant activity and functional group analysis of Evolvulus alsinoides. *Chin J Nat Med*, *12*(11), 827-32.

Hidalgo, M., Oruna-Concha, M. J., Kolida, S., Walton, G. E., Kallithraka, S., Spencer, J. P., & de Pascual-Teresa, S. (2012). Metabolism of anthocyanins by human gut microflora and their influence on gut bacterial growth. *Journal of Agricultural and Food Chemistry,* 60(15), 3882-3890.

Jemi, R., Barus, A.I., Nuwa, Sarinah, Luhan, G., (2017). Anti-Fungal activity of essential oil from Baeckea frutescens L against Pleuratus ostreatus. *AIP Conference Proceedings* 1904, 020002.

Kamarazaman, I.S., Ali N.A.M., Abdullah, F., Saad, N.C., Ali, A.A., Ramli, S., Rojsitthisak, P., Halim H., (2022). In vitro wound healing evaluation, antioxidant, and chemical profiling of Baeckea frutescens leaves ethanolic extract. *Arabian Journal of Chemistry*, 15:103871.

Lieke, S., Spiller, A., & Busch, G. (2023). Can consumers understand that there is more to palm oil than deforestation? *Sustainable Production and Consumption,* 39, 495–505. https://doi.org/10.1016/j.spc.2023.05.037

Navanesan, S., Wahab N.A., Manickam, A., Sim, K.S., (2015). Evaluation of selected biological capacities of Baeckea frutescens. *BMC Complementary and Alternative Medicine*, 15:186.

Razmavar, S., Abdulla, M. A., Ismail, S., & Hassandarvish, P. (2014). Antibacterial Activity of Leaf Extracts ofBaeckea frutescensagainst Methicillin-ResistantStaphylococcus aureus. *BioMed Research International*, 2014, 1–5. https://doi.org/10.1155/2014/521287.

Vauzour, D. (2014). Effect of flavonoids on learning, memory and neurocognitive performance: relevance and potential implications for Alzheimer's disease pathophysiology. *Journal of the Science of Food and Agriculture*, *94*(6), 1042-1056.