Gas Chromatography-Mass Spectrometry Profiling of Extracted Compounds for Gum Disease Treatment: A Methodological Approach

A'wani Aziz Nurdalila[1,2*], Nur Shuhaili Shamsuddin[2], Liyana Amalina Adnan[2], Ahmad Bazli Ahmad Hilmi[2]

[1]Institute of Fatwa and Halal (IFFAH), Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800, Nilai, Negeri Sembilan, Malaysia
[2]Kolej PERMATA Insan, Universiti Sains Islam Malaysia, 71800 Nilai, Negeri Sembilan, Malaysia

*Corresponding author: nurdalila.awani@usim.edu.my

ABSTRACT

The object of *Tamarindus indica* and *Brucea javanica* are investigated in this study as possible natural alternatives to allopathic medicines, focusing particularly on allergies and hyper-sensitivities towards synthetic chemicals in dental practices. Patient safety is a major concern given the adverse effects of drug allergies on care and results. The research sought to find out the therapeutic properties of these plants although there is need for more investigations into their efficacy. Extraction was done using acetone so as to obtain the extracts which exhibited several bioactive compounds. In rural areas, *Tamarindus indica* is often used for treating different diseases. Thereafter, the dry samples were ground into a fine powder, weighed accurately before placing them in a conical flask that contained hexane acetone solvent system at 4:1 ratio. The flask was then covered with an aluminum foil after being sealed overnight for 24 hours in order to allow complete extraction. The mixture was filtered separating the solid residue from solvent solution. This led to concentration of extracted compounds resulting into oil extract using rotary evaporator at 76°C and 264 atm. Solvent-to-sample weight ratio was 1:10; hence, ten milliliters per gram of sample were used during this process. This extraction method will be utilized for subsequent analysis using Gas Chromatography-Mass Spectrometry.

Keywords: *Tamarindus javanica*, *Brucea javanica*, gas chromatography-mass spectrometry, acetone solvent, extraction method

INTRODUCTION

Natural plant-based remedies have gained widespread attention as potential alternatives to conventional allopathic medicines due to their long-standing use in traditional medicine and their generally lower risk of adverse side effects (Kumar et al., 2022). Among these, *Tamarindus indica* and *Brucea javanica* are recognized for their extensive medicinal properties. *Tamarindus indica*, or tamarind, has been traditionally used in rural communities for treating various ailments, such as digestive disorders, infections, and inflammatory conditions (Patel & Gupta, 2018). Likewise, *Brucea javanica* is noted for its anti-inflammatory, anticancer, and antimicrobial effects, making it a promising candidate for medical applications (Wang et al., 2022). This study aims to explore the pharmacological potential of *Tamarindus indica* and *Brucea javanica*, focusing on their potential role as safer, plant-based alternatives to synthetic chemicals used in dental care. By integrating traditional medicinal knowledge with modern analytical techniques, this research seeks to provide insights that could improve patient safety and clinical outcomes, particularly for individuals with allergies and hypersensitivities to conventional drugs.

MATERIALS AND METHODS

Oven drying at 60°C for 24 hours was used to remove the moisture from the plant samples. After complete drying, samples were ground into fine powder with the help of mortar and pestle. Accurately weighed ground samples were transferred into a conical flask containing solvent mixture of hexane and ethyl acetate in a 4:1 ratio. The amount of solvent added was 1:10 from the weight of the sample. For instance, for every 1 g of sample there is 10 mL of solvent. The flask was sealed using aluminum foil and set aside for 24 hours.

After 24 hours, the mixture was filtered through filter paper to separate the solid residue from the solvent solution. The solvent containing the extracted compounds was taken in a rotary evaporator at 76°C and 264 ATM and was evaporated down to the extracted oil remaining in the flask. This oil was collected for further analysis. The use of hexane and ethyl acetate as solvents in a 4:1 ratio for extraction processes is a well-documented approach in lipid and oil extraction. For instance, hexane is commonly chosen for its efficacy in extracting non-polar compounds, while ethyl acetate is useful in extracting slightly polar compounds. This combination has been used effectively in food and natural product extractions (Henderson et al., 2011; Vagi et al., 2002)

The application of rotary evaporation to concentrate solvent mixtures is widely practiced in various extraction methodologies to obtain oil or other non-volatile components (Careri et al., 2001). Rotary evaporators are frequently used at controlled temperatures and pressures to safely remove solvents while preserving heat-sensitive compounds (Mendes et al., 1995; Canela et al., 2002).

RESULTS AND DISCUSSION

The extraction procedure followed in this study provides an important step in evaluating the therapeutic potentials of Tamarindus indica and Brucea javanica as natural alternative dental care agents, particularly in patients showing allergic manifestations or hypersensitivity to synthetic chemicals. Extraction with a solvent like acetone allowed the bioactive compounds in these plants to be extracted, and the hexane-acetone solvent system in a ratio of 4:1 improved the efficiency of extraction. It was a realistic adaptation of traditional medicine to the adoption of modern-day techniques of extraction, targeting rural communities that still rely on natural products, such as Tamarindus indica, in the treatment of diseases. The method has been effective in the isolation of compounds of interest, which are now available for further analysis for their bioactive potential.

Additionally, a rotary evaporator ensured the accurate removal of solvent, concentrated oil extracts under controlled conditions at 76°C at 264 atm. Refined extraction is important in retaining the integrity of these bioactive compounds, which would degrade under less controlled conditions. The 1:10 solvent-to-sample ratio was appropriate to attain maximum yield while minimizing the usage of solvent. However, whereas the method is effective for extraction, further studies are required on biological activity and efficacy evaluation of the extracts using Gas Chromatography-Mass Spectrometry (GC-MS). This would offer a better insight into the active principles and their possible therapeutic role in dental care.

The extraction process yielded oil extracts from both *Tamarindus indica* and *Brucea javanica*, which were concentrated using rotary evaporation. The yield of oil was significant, with the solvent-to-sample ratio of 1:10 proving efficient. The oil extracts displayed a rich concentration of compounds, visibly indicating successful extraction of bioactive components. The use of hexane and ethyl acetate in a 4:1 ratio effectively solubilized both non-polar and slightly polar compounds, as confirmed by the noticeable presence of oils post-evaporation.

The rotary evaporator maintained precise conditions at 76°C and 264 atm, ensuring that the heat-sensitive compounds were not degraded, preserving the integrity of the extracted oils. The concentrated oils are ready for further analysis by GC-MS to identify the specific bioactive compounds, their structure, and potential medicinal properties.

CONCLUSION

This work highlights the potential use of Tamarindus indica and Brucea javanica as alternative natural products in dentistry in order to avoid any synthetic chemicals that may cause allergic problems or hypersensitivity. The extraction of the samples using acetone and a hexane-acetone solvent system was effective, and the bioactive compounds were concentrated by rotary evaporation. Its ease and efficiency therefore encourage this method in the isolation of therapeutic compounds from these plants. These preliminary results are promising, but further studies using techniques like GC-MS are required for complete elucidation of the chemical constitution and therapeutic action of the extracts. This study finally lays a platform for possible clinical application of such natural extracts and thus encourages safe, botanical alternatives in dental practice.

ACKNOWLEDGEMENT

The authors of this paper send their gratitude to the Halal Action Laboratory, Kolej PERMATA Insan, Universiti Islam Malaysia, and Bahagian PERMATA, KPM, for providing all laboratory facilities, apparatus, and financial assistance for this project. The research financials were fully supported by the Universiti Sains Islam Malaysia (USIM) under research grant: PPPI /BM/DB/KGI/USIM/15423.

REFERENCES

Careri, M., et al. 2001."Application of Rotary Evaporation for Natural Product Extraction". *Journal of Agricultural and Food Chemistry*, Vol. 49(4). p. 1518–1525.

Henderson, R. K., et al. 2011. "Expanding GSK's Solvent Selection Guide: Embedding Sustainability into Solvent Selection Starting at Medicinal Chemistry". *Green Chemistry*, Vol. 13(4). p. 854–862.

Kumar, N., Saggar, S., Mir, P.A., Chawla, A., Uppal, J., Shilpa, S., & Kaur, A. 2022. "Traditional and Herbal Medicines: Opportunities and Challenges". *Pharmacognosy Research*, Vol. 14(2). p. 107–114.

Patel, R. & Gupta, M. 2018. "Traditional Uses of Tamarindus indica in Rural Areas". *Journal of Ethnopharmacology.*

Vági, E., et al. 2002. "Optimization of Extraction Techniques for Lipid Components from Oilseeds." *Journal of the American Oil Chemists' Society*, Vol. 79(6). p. 587–592.

Wang, X., Li, J., & Zhou, H. 2022. "Brucea Javanica: A Review of Pharmacology and Clinical Applications". *Journal of Medicinal Plant Research.*