Qualitative Analysis of Bioactive Compounds (Saponins) in Mauby Tree Bark (*Colubrina arborescens*)

Jessica Fey; Cheryl Rock, PhD; Dustin Moore, MS; Christine Costa DNP

Department of Family & Consumer Sciences

College of Health & Human Services, California State University Long Beach

Introduction

What is Mauby Tree Bark? [1, 2]

- Bark from the *Colubrina arborescens* tree species (Figure 1)
- Native to the Caribbean Islands and Florida
- **Mauby** → a bitter, dark liquid extracted from the bark (Figure 2)
  - ➢ A folk remedy used for diabetes, hypertension, and high cholesterol
  - ➢ Prepared as a refreshing carbonated beverage

Figure 1. *Mauby tree bark.*[7]

Figure 2. *Mauby syrup.*[7]

Mauby & Its Bioactive Compounds

- **Bioactive compounds** → extra-nutritional constituents that typically exist in small quantities in plants and foods[3]
  - ➢ Potentially decrease the risk of chronic disease development in humans[3]
- **Mauby** → novel source of bioactive compounds[1, 2]
- **Saponins** → found in plant species[4]
  - ➢ Classified by carbon skeleton during biosynthesis and physio-chemical properties.
  - ➢ **Distinctive medicinal properties**[5]
    - ❖ Cardiovascular, antidiabetic, anticancer, and immunological
  - ➢ Unique **foaming and emulsifying properties**[6]
    - ❖ Result of chemical structure (hydrophobic aglycone backbone + hydrophilic sugar molecules) → surface-active amphipathic compounds = foam

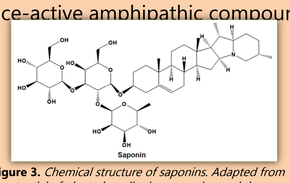


Figure 3. *Chemical structure of saponins. Adapted from "The potential of plant phenolics in prevention and therapy of skin disorders," by Dzialo et al., 2016, Int J Molecular Sciences, 17(2), 1-41.*[8]

What is Power Ultrasound (PU)?

- Type of ultrasound-assisted extraction technology [5]
  - ➢ Commonly used in food and pharmaceutical industries
  - ➢ Processes plant materials → denaturing plant cell walls
  - ➢ May result in greater extraction yields of bioactive compounds, such as saponins
  - ➢ A "green" and eco-friendly technology
    - ❖ Less hazardous chemical solvents
    - ❖ Energy efficient

The purpose of this study is to detect saponins by evaluating the qualitative characteristics (i.e., presence of foam) of Mauby bark powder solution prepared using (1) traditional boiling method and (2) power ultrasound method for 30 minutes each.

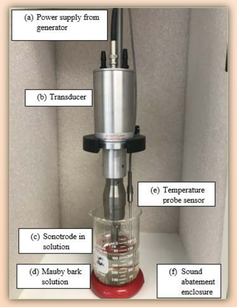
Methods

Obtained imported Mauby bark samples from a 3rd party vendor in Trinidad → Ground samples to a fine powder using a commercial food homogenizer → Processed bark using two methods: Traditional Boiling (Figure 4) and PU (Figure 5A, B) → Prepared and performed each method in triplicate

Traditional Boiling

Figure 4. *Mauby powder in boiling distilled H_2O for 30 minutes.*[7]

Power Ultrasound



Figures 5A and B. *(A) PU assembly begins with (a) the power supply cord from the generator, which is attached to (b) the transducer for the energy to be transferred into ultrasonic waves via (c) the sonotrode inserted directly into (d) the Mauby bark powder in ddH20. To measure temperature, (e) the temperature probe sensor is also inserted in the solution. All of which is enclosed in (f) the sound abatement enclosure to minimize the noise resulting from ultrasonic processing; and (B) processing of powdered Mauby bark.*[7]

Results

- The foam was evaluated using a qualitative grading scale with the following descriptors:
  0 - Absent; 1 - Present; 2 - Slightly Present; and 3 - Heavily Present

The traditional boiling method yielded more foam than the PU method

3

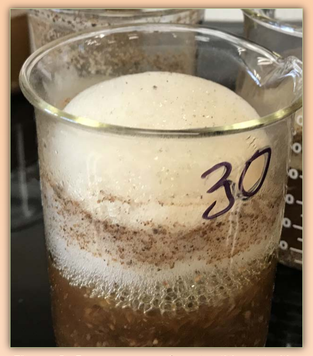


Figure 6. *Foam presence from traditional boiling method.*[7]

1

Figure 7. *Foam presence from PU method.*[7]

Discussion

- Looks can be deceiving! Though, the PU had less foam present, it does not mean there are less saponins in the Mauby solution.
  - ❖ PU uses a process called **cavitation** to burst the plant cell to release the intracellular contents, such as saponins (Figure 8)[9]
  - ❖ Hence, less foam is present in the PU samples; however, the extracted saponins are potentially greater in number than the boiled samples.

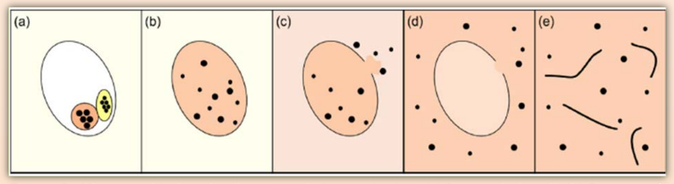


Figure 8. *Ultrasound-induced cell rupture during sonication. (a) Intact whole cell, (b) Rupture of intracellular structures, such as plastids, with consequent dispersion of molecules into the cytoplasm, (c) Cell wall rupture, (d) Release of intracellular components, (e) Dispersion of components into solution. Adapted from "Ascorbic acid stability in fruit juices during thermosonication," by Aguilar et al., 2017, Ultrasonics - Sonochemistry, 37, 375-381.*[9]

The Mechanisms of Saponins

- **Cholesterol-binding Activity**
  - ❖ Beneficial for cardiovascular disease and type 2 diabetes
- **Cytotoxic/Anti-Tumor Activity**
  - ❖ Potential chemotherapeutic agents
- **Anti-Inflammation Activity**
  - ❖ Positively regulate the immune system by suppressing inflammatory mediators
- **Adjuvant Activity**
  - ❖ Used in vaccine production due to their immune-enhancing properties
- **Hemolytic Activity**
  - ❖ Drug/herb interactions, such as warfarin, must be monitored to avoid dangerous blood thinning

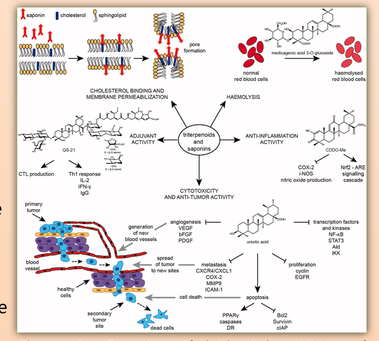


Figure 9. *Overview of biological activities of triterpenoids and saponins in animals. The structures of representative compounds for each activity are given, together with the various molecular targets and affected pathways. Gene, pathway or metabolite activation and inhibition are indicated by arrow heads and blunt ends, respectively.* [6] *Adapted from "Metabolic and functional diversity of saponins, biosynthetic intermediates and semi-synthetic derivatives," by Moses et al. 2014, Critical Reviews in Biochemistry and Molecular Biology, 49(6), 439-462*

Conclusion

Further analyses must be performed using High-Performance Liquid Chromatography (HPLC) to acquire quantitative results as well as identify specific types of saponins found in Mauby bark powder.

References

1. Alleyne, T., Roache, S., Thomas, C., & Shirley, A. (2005). The control of hypertension by use of coconut water and mauby: Two tropical food drinks. *The West Indian Medical Journal, 54*(1), 3-8.
2. Sorbera, M., Joseph, T., & Digregorio, R. V. (2017). Elevated international normalized ratio in a patient taking warfarin and mauby: a case report. *Journal of Pharmacy Practice, 30*(5), 567-570.
3. Kris-Etherton, P.M., Hecker, K.D., Bonanome, A., Coval, S.M., Binkoski, A.E., Hilpert, K.F., . . . Etherton, T.D. (2002). Bioactive compounds in foods: Their role in the prevention of cardiovascular disease and cancer. *The American Journal of Medicine, 113*(9), 71-88.
4. Vincken, J., Heng, L., De Groot, A., & Gruppen, H. (2007). Saponins, classification and occurrence in the plant kingdom. *Phytochemistry, 68*(3), 275-297.
5. Cheok, C., Yoong, S., Hanaa A.K., & Sulaiman, R. (2014). Extraction and quantification of saponins: A review. *Food Research International, 59*, 16-40.
6. Moses, T., Papadopoulou, K., & Osbourn, A. (2014). Metabolic and functional diversity of saponins, biosynthetic intermediates and semi-synthetic derivatives. *Critical Reviews in Biochemistry and Molecular Biology, 49*(6), 439-462.
7. Image source: Food Science and Nutrition Laboratory, California State University, Long Beach, 2017; 2018)
8. Image source: Dzialo, M., Mierziak, J., Korzun, U., Preisner, M., Szopa, J., & Kulma, A. (2016). The potential of plant phenolics in prevention and therapy of skin disorders. *International Journal of Molecular Sciences, 17*(2), 1-41.
9. Aguilar, K., Garvin, A., Ibarz, A., & Augusto, P.E.D. (2017). Ascorbic acid stability in fruit juices during thermosonication. *Ultrasonics - Sonochemistry, 37*, 375-381.