SOUTHERN JOURNAL OF SCIENCES

ESTABLISHED IN 1993

COMPARATIVE STUDY OF ALCOHOLIC EXTRACTION OF COMPOUNDS FROM ARAUCARIA ANGUSTIFOLIA: MICROWAVE-ASSISTED EXTRACTION VS. MACERATION EXTRACTION

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Received 06 February 2023; received in revised form 16 May 2022; accepted 03 June 2023

ABSTRACT

Background: The *Araucaria angustifolia* is a prominent tree species indigenous to the southern regions of Brazil. The tree can be a source of different compounds of interest if properly used. **Aims:** This research aims to compare the alcoholic extraction of compounds from Araucaria angustifolia using two different methods, microwave-assisted extraction and maceration extraction. **Methods:** Alcahoolic extractions of compounds from the sawdust of Araucaria angustifolia were performed using microwave-assisted extraction and maceration extraction. The color was observed by eye inspection. The taste was observed by putting the samples into the mouth and tasting it. The olfactive test was conducted at hot and cold temperatures. **Results:** it was obtained red color solution, both from the bark and from the branch. The intensity of the color changed with the extraction method and time of maceration. The solutions tasted like "green wood". **Discussion:** MAE and Maceration extraction can provide extracts from the bark and branch of the araucaria tree. There is the possibility that the “green wood” taste of the MAE extract can be changed with the thermal treatment of the wood. **Conclusions:** microwave-assisted extraction can perform the faster extraction of compounds from Araucaria angustifolia than maceration extraction.

Keywords: *Araucaria angustifolia, Microwave-assisted extraction*, *Maceration extraction*.

1. INTRODUCTION

Araucaria angustifolia (Figure 1), commonly known as the Paraná pine or Brazilian pine, is a prominent tree species indigenous to the southern regions of Brazil, Paraguay, and Argentina (Fritzsons *et al.*, 2018; Peralta *et al.*, 2016). This evergreen conifer holds immense ecological and economic significance due to its distinct characteristics and diverse applications. With its characteristic symmetrical growth pattern and umbrella-shaped crown, Araucaria angustifolia stands as a prominent component of the region's biodiversity and contributes to ecosystem stability. Araucaria angustifolia produces edible seeds, known as *pinhão*, and bioactive compounds, among other products (Castrillon *et al.*, 2023; Silva *et al.*, 2016; Branco and Rodrigues, 2016). Conservation efforts are supported by law (Brazil, 2006), and sustainable management practices are vital to preserve the genetic diversity of Araucaria angustifolia and ensure the continued provision of its ecosystem services.

Figure 1. Araucaria angustifolia.

Microwave-assisted extraction (MAE) is a powerful technique to extract bioactive compounds from various plant sources efficiently. This method employs microwave energy to enhance the extraction process, resulting in higher yields and shorter extraction times than conventional methods. MAE works by subjecting the plant material to microwave radiation, which induces internal heat generation and facilitates the release of target compounds. MAE offers numerous advantages, including improved extraction efficiency, reduced solvent consumption, and controlled extraction parameters. Several studies have demonstrated the effectiveness of MAE in extracting bioactive compounds from plants. For example, Alchera *et al.* (2022) investigated the extraction of polyphenols from blackcurrant using MAE and observed higher extraction efficiency than conventional methods. Additionally, Drinić *et al.* (2021) explored the extraction of essential oil, hydrolat, and residual water extract from *Sideritis raeseri* using MAE and Hydro-distillation, it was reported enhanced extraction yields. These studies, along with others (e.g., Hamid Nour *et al.*, 2021; Hiew *et al.*, 2022; Quiroz *et al.*, 2019), highlight the potential of MAE as a valuable technique for extracting bioactive compounds from various plant sources.

Maceration extraction is a traditional and widely used method for extracting bioactive compounds from plant materials. This technique involves immersing the plant material in a suitable solvent for an extended period, typically ranging from several days to weeks, allowing for the gradual release of target compounds. Maceration extraction offers several advantages, including simplicity, low cost, and the ability to extract a broad range of compounds. Numerous studies have utilized maceration extraction to extract bioactive compounds from various plants. For instance, Yang *et al.* (2015) investigated the antidiabetic effects of flavonoids from Sophora flavescens EtOAc extract in type 2 diabetic KK-ay mice. Additionally, Hasni *et al.* (2021) compared the maceration and ultrasound-assisted extraction methods to obtain phenolic-rich extracts from *Eucalyptus marginata* L., it was found that the ultrasound-assisted extraction method was more efficient than the maceration method. These examples, along with others (e.g., Jurinjak *et al.*, 2022; Koraqi *et al.*, 2023; Suksaeree *et al.*, 2021), demonstrate that traditional maceration extraction is an effective method to obtaining bioactive compounds from different plant sources.

This research aims to compare, visually and by taste, the alcohol extraction of compounds from Araucaria angustifolia using two different methods: Microwave-Assisted Extraction (MAE) and Maceration Extraction. The study aims to evaluate the efficiency and effectiveness of these two extraction techniques in obtaining bioactive compounds from Araucaria angustifolia. By employing MAE, which utilizes microwave energy to enhance the extraction process, it is expected to achieve higher extraction yields and reduced extraction times compared to traditional maceration extraction. The comparison will provide valuable insights into the advantages and limitations of each technique in extracting bioactive compounds from Araucaria angustifolia.

2. MATERIALS AND METHODS

2.1. Materials

- Samples of bark and branches;
- Cheap, low-quality vodka (ethanol source);
- Sawmill for making sawdust;
- Microwave oven;
- Glassware;
- Refrigerator;
- Thermometer;
- Reagent water type IV.

2.2. Methods

2.2.1. Conversion of wood samples into sawdust

To increase the surface area, the wood samples were converted into sawdust. Figure 2 shows a cut from the samples.

Figure 2. Cut from bark and branch samples.

2.2.2. Microwave-assisted extraction (MAE)

About 100g of the bark sawdust and 100g of the branch sawdust were submerged in becker glasses with enough vodka to cover them.

The samples were taken separately into the microwave for MAE. Once it achieved hot temperature (near boiling point), it was placed inside a freezer to reduce the temperature to nearly 0 °C. The heating and cold cycles were performed three times for each sample.

Later the samples were filtered and stored for further observation.

2.2.3. Maceration extraction

About 100g of the bark sawdust and 100g of the branch sawdust were washed with reagent water type IV and later submerged in becker glasses with enough vodka to cover them.

The samples were stored for about 20 days in a closed container at room temperature (near 20 °C), protected from light.

Later the samples were filtered and stored for further observation.

2.2.4. Color, taste, and olfaction observations

The color was observed by eye inspection.

The taste was observed by putting the samples into the mouth and tasting it.

The olfactive test was conducted at hot and cold temperatures.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Results of the conversion of wood samples into sawdust

The surface area was increased, and the sawdust had different colors depending on the section of the tree. Figure 3 illustrates the red bark sawdust. The branch samples had a yellow wood color.

Figure 3. Red bark sawdust.

3.1.2. Results of the Microwave-assisted extraction (MAE)

The samples extracted from the bark were deep red, as in Figure 4. Looking at it against a small led light (Figure 5) it was possible to note the red color (Figure 6).

Figure 4. Bark sawdust Microwave-assisted extract.

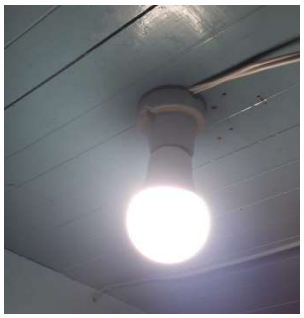

Figure 5. Light bulb.

Figure 6. Red color observed against a light bulb.

The samples from the branch were also red, but not so dark.

3.1.2. Results of the Maceration extraction

After about 20 days, the color of the samples was also red. Figure 7 shows the initial phase of the maceration.

Figure 7. Whasing the samples with reagent water type IV.

3.1.3. Results of the Color, taste, and olfaction observations

a) Regardless of the method, all samples achieved a red color. However, the tone was not the same;

b) The taste of the blank sample was bad (pure vodka). It had a strong ketone taste, confirming its low quality. The taste of the MAE extracts reminded “green wood”; even so, it appears better than the blank sample result. Tasting it too much may cause side effects that may compromise the objectivity of the tasting methodology. No teste test was performed in the maceration extraction method.

c) Hot olfaction test results point to the presence of alcohol vapors. Cold olfaction test results were inconclusive.

3.2. Discussions

Both methods, MAE and Maceration extraction, can provide extracts from the bark and branch of the araucaria tree. The difference relies on the extraction time. For the MAE, in a few hours, less than a day, all the extraction was complete. For the maceration, the time was much longer.

A possible reason for the vodka taste being less worse in the MAE extract than in the original sample is the evaporation of the ketones. There is the possibility that the “green wood” taste of the MAE extract can be changed with the thermal treatment of the wood. This fact must be studied further in the future, as it can create new

applications for the wood and bark of the Araucaria angustifolia.

The red color was a fascinating surprise; after about six months of the extraction, the color was still stable, creating the possibility for use as a natural dye for the beverage industry if the taste issue can be improved. The color looks golden red when observed in flasks that are not so thick, as in Figure 8.

Figure 7. Different ton colors of samples in flasks that are not so thick.

Due to the limitations in the analytical methods of this research, some samples were shared with other colleagues with better analytical and testing procedures.

4. CONCLUSIONS

The microwave-assisted extraction can perform the faster extraction of compounds from Araucaria angustifolia than maceration extraction. The tasting result from the method, as it was applied, does not allow consideration for using this wood to promote flavors for beverages, and more studies must be performed before its total disregard.

5. DECLARATIONS

5.1. Study Limitations

The study is limited to the sample size and the methods used in the research.

5.2. Acknowledgements

The author is grateful to Antec Móveis e Tecnologia for assisting in the conversion of the samples into sawdust.

5.3. Funding source

The author funded this research.

5.4. Competing Interests

The author declares that no conflict of interest exists in this publication.

5.5. Open Access

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