Investigating the methods for obtaining extracts from two types of herbal substances from elderberry, *Sambucus nigra L.*

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Introduction

Besides the most abundant flavanols (quercetin and apigenin) in the flowers, sambunigrin is mostly represented in the leaves. Some triterpenes, sterols, amino acids (glutamic acid, aspartic acid, and alanine), as well as lectins, have also been reported in leaves and branches of elderberry, *Sambucus nigra L.'*

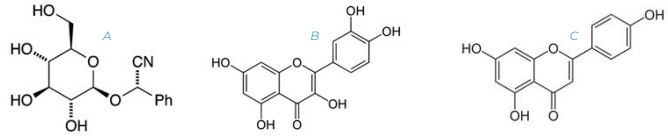


Fig.1: Chemical structures of sambunigrin (A), quercetin (B) and apigenin (C)

Sambucus nigra L. belongs to the Adoxaceae family and has gained recognition for its medicinal properties, particularly its flowers and fruits, which are rich in anthocyanins and other polyphenols. These bioactive compounds are valued for their antioxidant and anti-inflammatory effects, making elderberry a popular traditional remedy for alleviating early symptoms of colds and supporting immune health.

This study aims to compare the yields in extracts obtained via different extraction methods on two types of herbal substances Sambucus nigra L..

Fig.2: Elderberry plant

Fig.3: Elderberry flowers (fresh)

Fig.4 Elderberry flowers (dry)

Materials and Methods

We investigated two different methods of extraction: Soxhlet extraction (SOX) and Ultrasound-Assisted Extraction (UAE), against the conventional method for obtaining herbal infusions from two types of herbal substances: elderberry flower and elderberry herb (leaf with branches).

1. Plant Material:

Sambucus nigra L., flowers and leaves, collected near the Prilep region in May, 2024. Freshly harvested flowers and leaves were collected and, representative material was used for further experiments.

2. Preparation and Extraction:

The dried plant samples were processed using two solvents: ethanol and distilled water. Three extraction methods were used: traditional infusion, ultrasonic extraction (UAE), and Soxhlet extraction (SOX), resulting in a total of 9 extracts. The extracts were stored at a temperature of 2-4°C until spectrophotometric measurements were performed.

3. Extraction Methods:

1. Soxhlet Extraction (SOX):

The plant material (10 g of dry flowers and leaves) was placed in filter paper capsules, and ethanol (150 mL) was used as the extraction solvent. The Soxhlet apparatus heated the solvent, which condensed and passed through the plant material multiple times over a period of 4 hours. The resulting extracts were filtered and stored at 2-4°C.

2. Ultrasonic Extraction (UAE):

The plant material was sonicated in an ultrasonic bath at 40-45°C for 4 hours using ethanol. The ultrasonic waves helped break down the plant cell walls, enhancing extraction efficiency. The resulting extracts were filtered and stored at 2-4°C.

3. Infusion:

Fresh infusions were prepared by immersing the plant material in hot distilled water (98-100°C) for 15 minutes. Samples were filtered, and the extracts were stored at 2-4°C.

Fig. 5 and 6: Soxhlet extraction of elderberry flower

Fig. 7: Elderberry infusions - water bath

Results

Fig. 7: Absorbances of elderflower extracts from infusion, SOX, and UAE after 1:1 dilution 1 - elderflower infusion after 10 min; 2 - elderflower infusion after 15 min; 3 - elderflower infusion after 20 min; 4 - undiluted elderflower extract from SOX; 5- elderflower extract 1:1 dilution from SOX, 6- elderflower extract 1:2 dilution from SOX, 7 - undiluted elderflower extract from UAE; 8 elderflower extract from UAE 1:1 dilution; 9- elderflower extract from UAE 1:2 dilution.

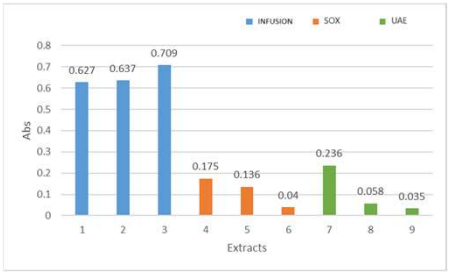
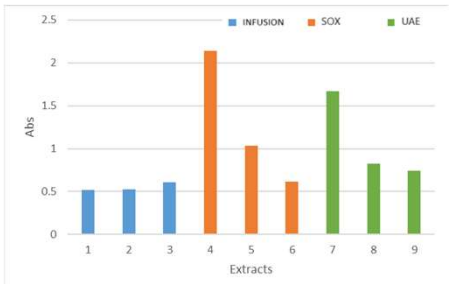


Fig. 8: Absorbances of elderleaf extracts from infusion, SOX, and UAE after 1:1 dilution1 - leaf infusion after 10 min; 2 - leaf infusion after 15 min; 3 - leaf infusion after 20 min; 4 - undiluted leaf extract from SOX; 5 - 1:1 leaf extract from SOX; 6 - 1:2 leaf extract from SOX; 7 - undiluted leaf extract from UAE; 8 - 1:1 leaf extract from UAE; 9 - 1:2 leaf extract from UAE.



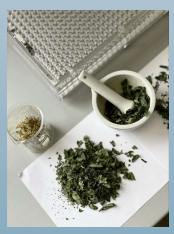


Fig. 10: Preparation of the drug

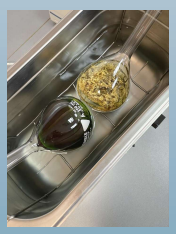


Fig. 11 Elderberry in an US bath

Fig. 12 Flower extract before filtration

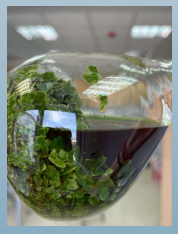


Fig.13: Leaf extract before filtration

Fig. 14: Infusion in bather bath

Fig. 15: : Filtering the infusion

Fig. 16> Elderberry leaf extracts

Fig.17: Elderflower extract

Conclusion

The results revealed significant differences between the yields of extracts from different plant parts—leaves vs. flowers. Among the extraction methods, Soxhlet extraction (SOX) proved to be the most effective compared to the conventional infusion method. The yield in ethanol Soxhlet extracts, was nearly 10 times higher for leaves (1.032) compared to flowers (0.136).

Soxhlet and UAE used ethanol as the solvent, while infusions were prepared with water. Water was ideal for extracting elderflower but showed weak potential for extracting bioactive compounds from elder leaves. Elderflowers predominantly contain flavonols like quercetin and apigenin, while sambunigrin is prevalent in the leaves. Additionally, leaves contain terpenes, sterols, amino acids (glutamic acid, aspartic acid, alanine), and lectins. Due to the hydrophobic nature of these bioactive compounds, water is not suitable for leaf extraction, unlike flowers which have hydrophilic compounds making water a suitable solvent.

The extracts can be used for experimental purposes to investigate their medicinal properties and pharmaceutical applications, as well as their incorporation in different technological formulations for cosmetic products and supplement.