УДК 581.6

A Comparative Study of Conventional Techniques for the Extraction of *Salvia officinalis*

Sharabati A. (ITMO)
Scientific Supervisor – PhD Eremeeva N.B. (ITMO)

Introduction. Sage (*Salvia officinalis*), a widely used herb for flavoring and culinary purposes, has been used in traditional medicine for thousands of years, dating back to ancient Roman and Greek times, around 1500 BC. The name “Salvia” derives from the Latin “salvare” meaning “to save”, “to cure”, or “to heal”. Sage is thought to be the oldest in history among medicinal herbs [1,2]. *Salvia officinalis* is used for several purposes, including, seasoning, cookery perfumery, and, moreover, medical; where the plant has shown enormous medically beneficial activities and properties [1,3,4].

Sage is believed to possess such versatility due to its diverse and rich profile of bioactive substances and phytochemicals, where countless substances have been successfully isolated and attributed to certain functions [1,2].

Several methods have been introduced in order to isolate certain substances or potentiate their extractability [5]. Despite plant extracts being of main interest distinctive profiles of extracted phytochemicals and their concentrations have been acquired depending on the extraction method and conditions [6].

Our current study’s purpose is to compare conventional extraction techniques, using water and ethanol under different conditions, with the target of determining the technique of the highest feasibility, and effectiveness in the retention of flavonoid and phenolic compounds, along with the antioxidant activity; the results of which are to be used in further studies.

Main Body. Sage plant (*S. officinalis*) was brought in the vital form, the leaves were ground to a fine powder form by crushing them, which was done by the help of mortar and pestle in addition to liquid nitrogen.

Extraction was carried out using two solvents: water and 70% ethanol, and three main techniques were used: ethanol extraction; by dissolving the crushed leaves in 70% ethanol, boiling extraction; through dissolving the crushed leaves in water and boiling it for a while, and pressurized hot water extraction (PHWE); through dissolving the crushed leaves in water and keeping them in tightly sealed autoclaves, and heating them in the oven at 160°C. Along with the three main methods of extraction, three more conditions were applied to samples differently in order to diversify them: heating duration (for boiling extraction and PHWE): 10 minutes, 20 minutes, incubation temperature; at room temperature, at 37°C, and incubation time; 8 hours, 16 hours. That way 20 samples of different extraction conditions were obtained. For testing different conditions of samples for a further stage of the research (encapsulation), the same 20 samples extracted in different conditions were extracted twice, using the same different conditions, in two different sample-to-solvent ratios: 1:20 and 1:40, making up 40 samples of different conditions. After that, the samples were filtered and kept in the freezer.

Three tests were performed in order to assess the effectiveness and quality of the extraction method: total flavonoid content (TFC), total phenolic content (TPC), and antioxidant activity (using DPPH). All

the samples were tested at the same time in order to ensure similar conditions of extraction and rule out any confounding factors.

Conclusion. The results suggest that TPC and TFC, as well as antioxidant activity showed to be higher when extraction was carried out using boiling water, which agrees to the results found in [7]. However, it's important to note that some articles also showed that ethanol extraction can function more efficiently in the extraction of other profiles or phytochemicals [5,7].

References.

1. Altindal D, Altindal N. Sage (Salvia officinalis) Oils. Essential Oils in Food Preservation, Flavor and Safety. 2016 Jan 1;715–21.

2. Topçu G. Bioactive triterpenoids from Salvia species. J Nat Prod [Internet]. 2006 Mar [cited 2025 Jan 6];69(3):482–7. Available from: https://pubs.acs.org/doi/full/10.1021/np0600402

3. Abdel Rahman AN, Van Doan H, Elsheshtawy HM, Dawood A, Salem SMR, Sheraiba NI, et al. Dietary Salvia officinalis leaves enhances antioxidant-immune-capacity, resistance to Aeromonas sobria challenge, and growth of Cyprinus carpio. Fish Shellfish Immunol. 2022 Aug 1;127:340–8.

4. Afonso AF, Pereira OR, Fernandes Â, Calhelha RC, Silva AMS, Ferreira RCF, et al. Phytochemical Composition and Bioactive Effects of Salvia africana, Salvia officinalis 'Icterina' and Salvia mexicana Aqueous Extracts. Molecules [Internet]. 2019 Nov 27 [cited 2025 Jan 4];24(23):4327. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC6930492/

5. Bitwell C, Indra S Sen, Luke C, Kakoma MK. A review of modern and conventional extraction techniques and their applications for extracting phytochemicals from plants. Sci Afr. 2023 Mar 1;19:e01585.

6. Arceusz A, Occhipinti A, Capuzzo A, Maffei ME. Comparison of different extraction methods for the determination of α- and β-thujone in sage (Salvia officinalis L.) herbal tea. J Sep Sci [Internet]. 2013 Sep 1 [cited 2025 Jan 18];36(18):3130–4. Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/jssc.201300206

7. Parí SM, Juárez MLM, Vilca FZ, Vilca OML, Alca EEA, Escobedo-Pacheco E, et al. Alternative green extraction techniques to enhance recovery of antioxidant compounds from red peel prickly pear (Opuntia ficus-indica L. Miller). Discover Food [Internet]. 2024 Dec 1 [cited 2025 Jan 29];4(1):1–12. Available from: https://link.springer.com/article/10.1007/s44187-024-00140-5