LETTERS IN BIOMATHEMATICS
An International Journal

RESEARCH ARTICLE

OPEN ACCESS

Comparative Phytochemical and Nutritional Profiling of Buxus papillosa and Salvia hispanica Seeds: Implications for Antioxidant and Anti-Inflammatory Therapeutic Potential

Alka Sharma[1]*, Ravinesh Mishra[2], Bhartendu Sharma[2]

[1]*Research Scholar, School of Pharmacy and Emerging Sciences, Baddi University of Emerging Sciences & Technology, Baddi Makhnumajra- 173205, H.P. India.
[2]Professor, School of Pharmacy and Emerging Sciences, Baddi University of Emerging Sciences & Technology, Baddi Makhnumajra-173205, H.P. India.

ABSTRACT

Background: Medicinal seeds are important sources of nutrients and bioactive phytoconstituents with potential pharmaceutical applications. However, comparative information on the nutritional and phytochemical characteristics of Buxus papillosa and Salvia hispanica seeds remains limited. The present study aimed to comparatively evaluate the pharmacognostical, physicochemical, nutritional, mineral, vitamin, extractive, and phytochemical characteristics of these two seed materials and explore their potential relevance to antioxidant and anti-inflammatory applications.

Methods: Authenticated seeds of B. papillosa and S. hispanica were subjected to pharmacognostical evaluation, loss-on-drying determination, ash analysis, extractive-value determination, mineral and vitamin estimation, and qualitative phytochemical screening of their extracted seed oils. The investigated phytochemical classes included alkaloids, flavonoids, phenolic compounds, tannins, terpenoids, steroids, glycosides, saponins, and quinones.

Results: The two seeds demonstrated distinct pharmacognostical and nutritional profiles. B. papillosa showed a loss on drying of 6.76 ± 1.23%, compared with 8.12 ± 0.61% for S. hispanica. Total ash was 5.12 ± 0.26% and 7.12 ± 0.23%, respectively. S. hispanica showed substantially higher phosphorus (860 mg/100 g), potassium (666 mg/100 g), and calcium (600 mg/100 g), whereas B. papillosa contained higher zinc (25.95 mg/100 g) and sodium (26.85 mg/100 g). B. papillosa contained higher vitamin C (150 mg/100 g) and vitamin E (0.8 mg/100 g), whereas S. hispanica showed higher vitamin A, thiamine, riboflavin, and niacin. Hexane extractive values were 21.6 ± 0.65% for B. papillosa and 32.08 ± 0.123% for S. hispanica. Qualitative screening revealed alkaloids, flavonoids, phenolics, tannins, terpenoids, steroids, and quinones in both seed oils.

Conclusion: B. papillosa and S. hispanica demonstrated complementary nutritional and phytochemical characteristics. The presence of phenolic, flavonoid, terpenoid, steroid, and other bioactive constituents provides a basis for further investigation of these seeds as potential sources of antioxidant and anti-inflammatory agents.

ARTICLE HISTORY

Received October 17, 2026

Accepted November 21, 2026

KEYWORDS

Buxus Papillosa; Salvia Hispanica; Chia Seed; Phytochemical Screening; Nutritional Profiling; Minerals; Vitamins; Seed Oil; Antioxidant Potential; Anti-Inflammatory Potential.

1. Introduction

Medicinal plants and their seeds represent important sources of structurally diverse phytoconstituents and nutritional components with potential applications in pharmaceutical and nutraceutical research. The characterization of plant materials through pharmacognostical, physicochemical, nutritional, and phytochemical investigations is an essential step in establishing their quality and therapeutic relevance[1].

Buxus papillosa belongs to the family Buxaceae and has attracted scientific interest primarily because of its steroidal alkaloids and diverse biological activities. However, comparatively limited information is available regarding the detailed nutritional and phytochemical

CONTACT Alka Sharma: alka.sharma@baddiuniv.ac.in

characteristics of its seeds. In contrast, *Salvia hispanica* L., commonly known as chia, is a well-characterized nutritional seed belonging to the family Lamiaceae and is recognized for its nutritional constituents and biologically active phytochemicals[2,17].

The nutritional composition of seeds may contribute substantially to their biological value. In the present thesis, comparative mineral analysis demonstrated marked differences between the two species. *S. hispanica* contained substantially higher phosphorus, potassium, and calcium, whereas *B. papillosa* showed comparatively higher zinc and sodium[3].

Similarly, vitamin profiling revealed complementary nutritional characteristics. *B. papillosa* contained substantially higher vitamin C and slightly higher vitamin E, whereas *S. hispanica* contained higher vitamin A, thiamine, riboflavin, and niacin[4].

Beyond nutritional composition, secondary metabolites are particularly relevant to the pharmacological potential of medicinal seeds[6]. Qualitative screening of the extracted seed oils demonstrated the presence of **alkaloids, flavonoids, phenolic compounds, tannins, terpenoids, steroids, and quinones** in both oils, while saponins and cardiac glycosides were not detected under the experimental conditions[7,18].

Therefore, the present study was designed to provide a **comparative characterization of** *B. papillosa* **and** *S. hispanica* **seeds,** integrating pharmacognostical characteristics, physicochemical quality parameters, extractive values, mineral composition, vitamin profile, and qualitative phytochemical composition. The findings were further interpreted in the context of their potential antioxidant and anti-inflammatory relevance.

2. Materials and Methods

2.1 Plant Material

Seeds of *Buxus papillosa* and *Salvia hispanica* were used for comparative pharmacognostical, physicochemical, nutritional, and phytochemical evaluation. The thesis reports systematic investigation of the seeds covering pharmacognostical and phytochemical characteristics.

2.2 Pharmacognostical Evaluation

The raw seed materials were examined for appearance, texture, colour, taste, and odour.

2.3 Loss on Drying

Loss on drying was determined to assess the moisture content of the powdered seed materials. The thesis reports values of **6.76 ± 1.23%** for *B. papillosa* and **8.12 ± 0.61%** for *S. hispanica*.

2.4 Ash Values

Total ash, acid-insoluble ash, and water-soluble ash were determined using standard procedures.

2.5 Extractive Values

The powdered seeds were extracted using hexane, chloroform, ethanol, and water, and the percentage extractive values were determined.

2.6 Mineral Analysis

The mineral composition of the two seed materials was determined and expressed as mg/100 g dry weight. Macro-elements included phosphorus, potassium, sodium, and calcium, while iron, zinc, copper, and manganese were assessed as trace elements[8].

2.7 Vitamin Analysis

Vitamin A, vitamin E, vitamin C, thiamine, riboflavin, and niacin were comparatively evaluated in the two seed materials.

2.8 Seed Oil Extraction and Phytochemical Screening

Seed oils of *B. papillosa* and *S. hispanica* were subjected to qualitative phytochemical screening. The investigated constituents included alkaloids, flavonoids, phenolic compounds, tannins, saponins, terpenoids, steroids, glycosides, and quinones. All tests were performed in triplicate according to the methodology described in the thesis[9].

3. Results

3.1 Pharmacognostical Characteristics

The two seed materials exhibited distinct macroscopic characteristics.

Table 1. Pharmacognostical characteristics of *Buxus papillosa* and *Salvia hispanica* seeds

Parameter	*Buxus papillosa*	*Salvia hispanica*
Appearance	Powder	Powder/seed form
Touch	Fine and dry	Smooth and mucilaginous when wet
Colour	Yellowish brown	Greyish black to brown
Taste	Bitter and astringent	Mild, slightly nutty
Odour	Slightly aromatic, characteristic	Faint, characteristic

These characteristics are directly reported in the thesis.

3.2 Loss on Drying

B. papillosa exhibited lower moisture content than *S. hispanica*, with values of **6.76 ± 1.23%** and **8.12 ± 0.61%,** respectively.

Table 2. Loss on drying of *Buxus papillosa* and *Salvia hispanica* seeds

Seed	Loss on drying (% w/w)
B. papillosa	6.76 ± 1.23
S. hispanica	8.12 ± 0.61

3.3 Ash Values

Total ash was higher in *S. hispanica* (**7.12 ± 0.23%**) than in *B. papillosa* (**5.12 ± 0.26%**). Acid-insoluble ash values were relatively low in both samples.

Table 3. Ash values of *Buxus papillosa* and *Salvia hispanica* seeds

Parameter	***B. papillosa* (% w/w)**	***S. hispanica* (% w/w)**
Total ash	5.12 ± 0.26	7.12 ± 0.23
Acid-insoluble ash	0.45 ± 0.34	0.54 ± 0.76
Water-soluble ash	14.2 ± 0.12	1.23 ± 0.17

Important: The **14.2 ± 0.12% water-soluble ash value for** *B. papillosa* is reproduced exactly as reported in the thesis. It should be verified against the original laboratory record before submission because it is markedly different from the corresponding *S. hispanica* value.

3.4 Extractive Values

The highest extractive value for both seeds was obtained with hexane. *S. hispanica* showed higher extractive values than *B. papillosa* with all four solvents.

Table 4. Extractive values of *Buxus papillosa* and *Salvia hispanica* seeds

Extract	*B. papillosa* (% w/w)	*S. hispanica* (% w/w)
Hexane	21.60 ± 0.65	32.08 ± 0.123
Chloroform	9.20 ± 0.19	26.86 ± 0.47
Ethanol	8.70 ± 0.23	11.23 ± 0.34
Aqueous	11.33 ± 0.56	15.20 ± 0.12

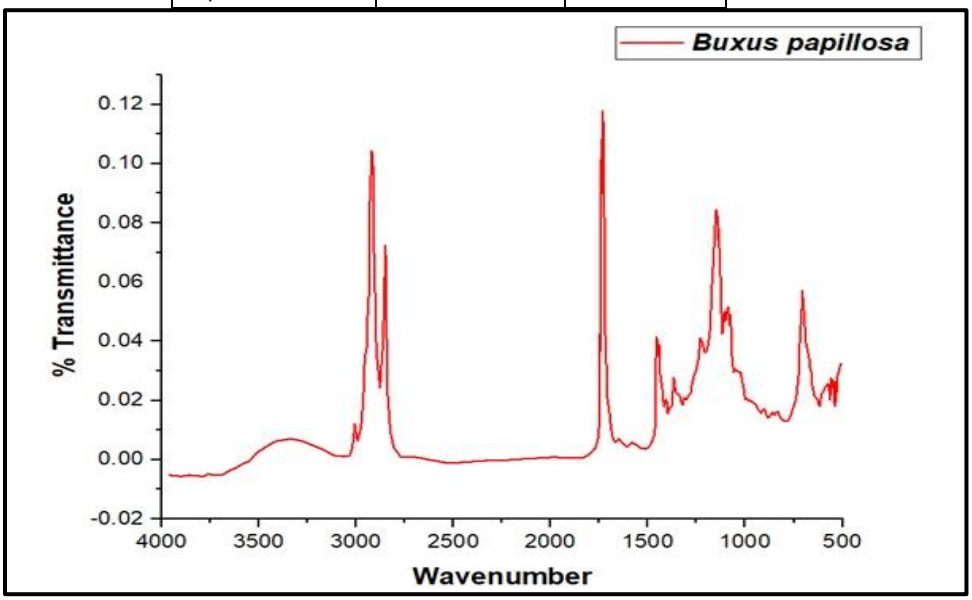


Fig. 1: FTIR spectroscopy of *Buxus papillosa* seed

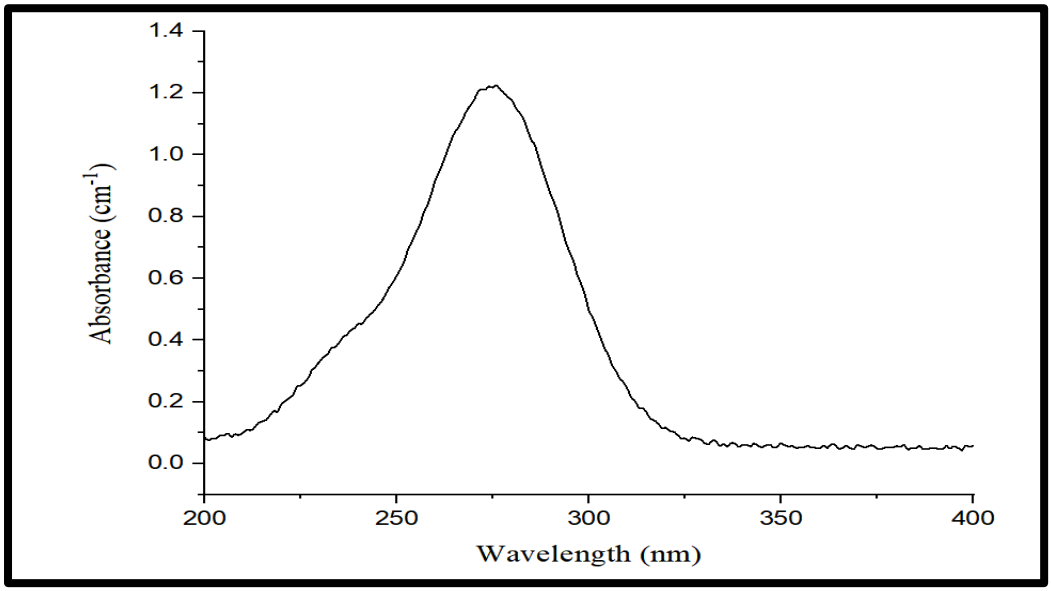
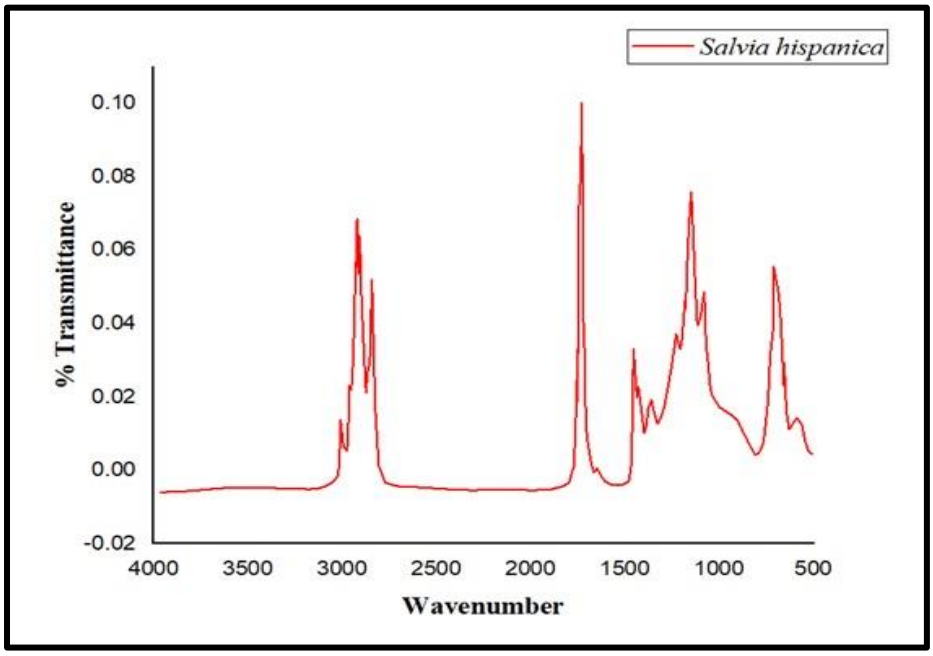


Fig. 2:UV Spectrum of *Buxus papillosa seed* oil.



ig. 3: FTIR spectroscopy of *Salvia hispanica* seed

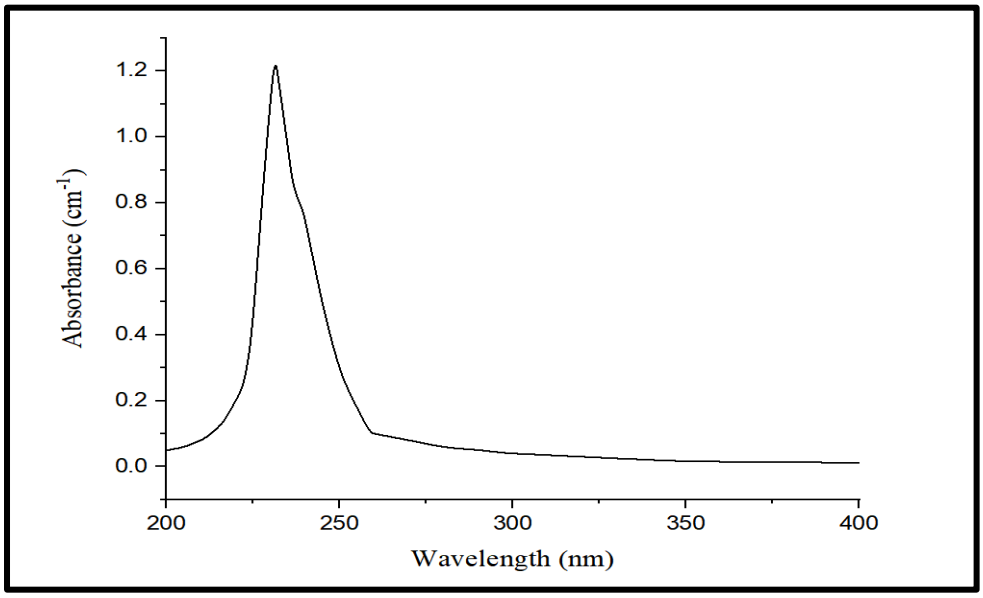


Fig. 4:UV spectrum of Salvia *hispanica seed* oil

3.5 Mineral Composition

The mineral profile demonstrated substantial interspecies differences. *S. hispanica* contained markedly higher phosphorus, potassium, and calcium, whereas *B. papillosa* contained higher sodium and zinc.

Table 5. Mineral composition of *Buxus papillosa* and *Salvia hispanica* seeds

Element	***B. papillosa*** **(mg/100 g)**	***S. hispanica*** **(mg/100 g)**
Phosphorus	44.37	860
Potassium	30.36	666
Sodium	26.85	16
Calcium	20.13	600

Iron	0.02	8
Zinc	25.95	5
Copper	1.10	0.92
Manganese	1.56	3.35

3.6 Vitamin Composition

The vitamin profiles were distinctly different. *B. papillosa* contained substantially more vitamin C and slightly more vitamin E, whereas *S. hispanica* contained higher vitamin A and B-complex vitamins.

Table 6. Vitamin composition of *Buxus papillosa* and *Salvia hispanica* seeds

Vitamin	***B. papillosa***	***S. hispanica***
Vitamin A equivalent	0.40	54
Vitamin E	0.80	0.50
Vitamin C	150	1.60
Thiamine (B1)	0.05	0.62
Riboflavin (B2)	0.04	0.17
Niacin (B3)	0.60	8.83

Unit: mg/100 g dry weight as reported in the thesis.

3.7 Qualitative Phytochemical Screening

Both seed oils showed positive reactions for **alkaloids, flavonoids, phenolic compounds, tannins, terpenoids, steroids, and quinones**. Saponins and cardiac glycosides were not detected under the experimental conditions.

Table 7. Comparative phytochemical profile of *Buxus papillosa* and *Salvia hispanica* seed oils

Phytoconstituent	***B. papillosa***	***S. hispanica***
Alkaloids	+	+
Flavonoids	+	+
Phenolic compounds	+	+
Tannins	+	+
Terpenoids	+	+
Steroids	+	+
Quinones	+	+
Saponins	–	–
Cardiac glycosides	–	–

+ = detected; – = not detected.

The thesis interpretation suggests that the phenolic and flavonoid profile of *S. hispanica* may contribute to antioxidant potential, whereas the comparatively higher terpenoid/steroid characteristics of *B. papillosa* may contribute to its pharmacological relevance.

3.8 Organoleptic Characteristics of Seed Oils

B. papillosa seed oil was pale yellow to light brown, with a strong aromatic odour and slightly bitter/pungent taste. *S. hispanica* seed oil was pale yellow with a mild nutty odour and taste.

Table 8. Organoleptic characteristics of *Buxus papillosa* and *Salvia hispanica* seed oils

Parameter	***B. papillosa* seed oil**	***S. hispanica* seed oil**
Colour	Pale yellow to light brown	Pale yellow
Odour	Strong aromatic	Mild nutty
Taste	Slightly bitter, pungent	Mild, slightly nutty

4. Discussion

The present comparative investigation demonstrates that *B. papillosa* and *S. hispanica* possess markedly different but potentially complementary nutritional and phytochemical profiles. Such differences are important when considering these seeds as sources of bioactive materials for pharmaceutical or nutraceutical applications.

The pharmacognostical evaluation revealed clear differences in colour, texture, taste, and odour, providing useful preliminary identification characteristics. The relatively lower loss-on-drying value of *B. papillosa* suggests a lower moisture content than *S. hispanica*, although both materials showed measurable moisture levels suitable for further processing[10].

The extractive-value analysis demonstrated that *S. hispanica* consistently produced higher extractive yields across hexane, chloroform, ethanol, and aqueous solvents. The particularly high hexane extractive value of *S. hispanica* is consistent with its recognized lipid-rich nature and supports its suitability for oil-based investigations[11].

The mineral analysis revealed a strong nutritional distinction between the two seeds. *S. hispanica* showed substantially greater phosphorus, potassium, and calcium concentrations, whereas *B. papillosa* demonstrated higher zinc and sodium. These minerals have important physiological roles, although their presence alone should not be interpreted as evidence of therapeutic efficacy[12].

The vitamin profile was similarly complementary. The high vitamin C value observed for *B. papillosa* was particularly notable, while *S. hispanica* demonstrated higher vitamin A, thiamine, riboflavin, and niacin values. These differences suggest that the nutritional contribution of the two seeds is not identical and may provide different biological advantages[13].

The qualitative phytochemical screening demonstrated seven common phytochemical classes in both seed oils. The detection of phenolic and flavonoid compounds is particularly relevant because these classes are frequently associated with antioxidant activity, whereas terpenoid and steroid constituents may contribute to diverse pharmacological effects[14]. However, **qualitative detection cannot establish potency, concentration, or direct therapeutic efficacy.** Quantitative phytochemical profiling and mechanistic assays would therefore be necessary to substantiate these proposed activities[15,19].

The complementary nature of the two profiles is particularly interesting. *B. papillosa* showed notable nutritional contributions from vitamin C, vitamin E, and zinc, together with a phytochemical profile containing terpenoids and steroids[16]. *S. hispanica*, on the other hand, showed higher levels of several minerals and B-complex vitamins and demonstrated the presence of phenolics and flavonoids in its seed oil. This complementary profile provides a scientific rationale for further investigation of both materials in antioxidant and anti-inflammatory research[17].

5. Conclusion

The comparative investigation demonstrated substantial differences in the nutritional, mineral, vitamin, extractive, and phytochemical profiles of *Buxus papillosa* and *Salvia hispanica* seeds. *B. papillosa* was particularly notable for its vitamin C, vitamin E, and zinc content, whereas *S. hispanica* demonstrated higher levels of several minerals and B-complex vitamins. Both seed oils contained multiple phytochemical classes, including phenolics, flavonoids, terpenoids, steroids, and alkaloids. These findings highlight the **complementary phytochemical and nutritional characteristics** of the two seeds and support further quantitative and mechanistic investigation of their antioxidant and anti-inflammatory potential.

6. Declarations

Ethics Statement

This manuscript reports comparative nutritional, pharmacognostical, and phytochemical investigations. **No animal experiment is required for the core experiments presented in this Paper 2.**

Funding

No specific external funding statement was identified in the thesis material reviewed for this manuscript.

Conflict of Interest

The author declares no conflict of interest.

References

Saleem H, Htar TT, Naidu R, Zengin G, Locatelli M, Tartaglia A. Phytochemical composition and enzyme inhibition studies of *Buxus papillosa* CK Schneid. Processes. 2020;8(7):757.

Ata A, Andersh BJ. Buxus steroidal alkaloids: chemistry and biology. The Alkaloids: Chemistry and Biology. 2008;66:191–213.

Saleem H, Htar TT, Naidu R, Ahmad I, Zengin G, Ahmad M. Investigations into the therapeutic effects of aerial and stem parts of *Buxus papillosa* CK Schneid.: in vitro chemical, biological and toxicological perspectives. Journal of Pharmaceutical and Biomedical Analysis. 2019;166:128–138.

Asif E, Ali SS, Nasir H, Jamal SA, Ata A, Farooq A. New steroidal alkaloids from the roots of *Buxus papillosa*. Journal of Natural Products. 1992;55(8):1063–1066.

Parveen S, Khalid A, Farooq A, Choudhary MI. Acetyl and butyrylcholinesterase-inhibiting triterpenoid alkaloids from *Buxus papillosa*. Phytochemistry**.** 2001;58(6):963–968.

Khan A, Ali S, Gilani A-H, Ahmed M, Choudhary MI. Antispasmodic, bronchodilator, vasorelaxant and cardiosuppressant effects of *Buxus papillosa*. BMC Complementary and Alternative Medicine. 2017;17(1):54.

Motyka S, Koc K, Ekiert H, Blicharska E, Czarnek K, Szopa A. The current state of knowledge on *Salvia hispanica* and *Salviae hispanicae* semen (chia seeds). Molecules. 2022;27(4):1207.

Bodoira RM, Penci MC, Ribotta PD, Martínez ML. Chia (*Salvia hispanica* L.) oil stability: Study of the effect of natural antioxidants. LWT. 2017;75:107–113.

Mohd Ali N, Yeap SK, Ho WY, Beh BK, Tan SW, Tan SG. The promising future of chia, *Salvia hispanica* L. BioMed Research International. 2012;2012:171956.

Jamboonsri W, Phillips TD, Geneve RL, Cahill JP, Hildebrand DF. Extending the range of an ancient crop, *Salvia hispanica* L.—a new ω3 source. Genetic Resources and Crop Evolution. 2012;59(2):171–178.

Kulczyński B, Kobus-Cisowska J, Taczanowski M, Kmiecik D, Gramza-Michałowska A. The chemical composition and nutritional value of chia seeds- Current state of knowledge. Nutrients**.** 2019;11(6):1242.

Knez Hrnčič M, Ivanovski M, Cör D, Knez Ž. Chia Seeds (*Salvia hispanica* L.): An overview- phytochemical profile, isolation methods, and application. Molecules. 2019;25(1):11.

Rahman MJ, de Camargo AC, Shahidi F. Phenolic and polyphenolic profiles of chia seeds and their in vitro biological activities. Journal of Functional Foods**.** 2017;35:622–634.

Abdel Ghani AE, Al-Saleem MSM, Abdel-Mageed WM, AbouZeid EM, Mahmoud MY, Abdallah RH. UPLC-ESI-MS/MS profiling and cytotoxic, antioxidant, anti-inflammatory, antidiabetic, and antiobesity activities of the non-polar fractions of *Salvia hispanica* L. aerial parts. Plants**.** 2023;12(5):1062.

Amtaghri S, Eddouks M. Ethnopharmacology, nutritional value, therapeutic effects, phytochemistry, and toxicology of *Salvia hispanica* L.: a review. Current Topics in Medicinal Chemistry. 2023;23(28):2621–2639.

Valdivia-López MÁ, Tecante A. Chia (*Salvia hispanica*): A review of native Mexican seed and its nutritional and functional properties. Advances in Food and Nutrition Research. 2015;75:53–75.

Sehrawat A, Singh S. Pharmacognostical standardization and preliminary phytochemical explorations on *Salvia hispanica* L. seeds. Journal of Drug Delivery & Therapeutics. 2019.

Kokate CK. Practical Pharmacognosy. 3rd ed. New Delhi: VPBN; 1991:107–111.

Association of Official Analytical Chemists (AOAC). Official Methods of Analysis of AOAC International. 1990.