Chemical composition and biological uses of *Artemisia schrenkiana* Ledeb

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Abstract. This article presents an analysis of the medicinal plants found in the domestic flora, emphasizing the significance of *Artemisia schrenkiana* Ledeb., which thrives in the southeastern region of Kazakhstan. The study aimed to identify the primary groups of biologically active compounds present in this plant species. The results revealed the presence of various compounds, including extractive substances (29.57%), coumarins (0.135%), carbohydrates (2.32%), tannins (10.06%), and amino acids (1.45%). Additionally, a total of 12 amino acids were identified. Notably, Artemisia schrenkiana Ledeb. exhibited significant levels of flavonoids (142.1±2.1mg CAE/g) and phenolic compounds (265.01±1.2mg GAE/g) among other constituents. These bioactive compounds contribute to the plant's pharmacological properties, encompassing antioxidant, anti-inflammatory, antimicrobial, and anticancer activities. Consequently, *Artemisia schrenkiana* Ledeb. holds promise as a valuable medicinal plant for combating various diseases. In summary, *Artemisia schrenkiana* Ledeb. emerges as a promising candidate for therapeutic and prophylactic purposes due to its diverse array of bioactive compounds. Continued investigation into its properties and potential applications is warranted to harness its full medicinal potential effectively.

1 Introduction

Medicinal plants possess potent healing properties, offering safety, efficacy, environmental friendliness, and minimal side effects, thus driving a growing demand worldwide [1]. According to the World Health Organization (WHO), traditional medicine encompasses practices, methods, and accumulated knowledge derived from life experiences, including plant, animal, and mineral-based remedies, spiritual therapies, and disease treatment techniques. Utilizing natural products for therapeutic purposes dates back to early medical practices [2].

Presently, medicines derived from plant sources are extensively utilized for treating and preventing various diseases, with their variety continually expanding [3,4]. Herbal remedies offer distinct advantages over synthetic drugs, including pleasant effects and low toxicity.

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However, in modern Kazakhstan, the potential of medicinal plants from the domestic flora remains underexplored, despite their significance in producing essential medications, cosmetics, and dietary supplements [5,6]. *Artemisia schrenkiana* Ledeb., commonly known as Schrenk's wormwood, belongs to the *Asteraceae* family and the *Artemisia genus* [7]. This versatile plant thrives in diverse ecosystems across Eastern Kazakhstan, including the Altai Mountains, salty steppes of the Central Tien-Shan Mountains, and the shores of forests and salt lakes. Its adaptability allows it to flourish in various climatic zones, such as deserts, semi-deserts, forests, wetlands, and rocky mountain surfaces [8].

This article presents an analysis of the utilization of domestic medicinal plants, focusing on *Artemisia schrenkiana* Ledeb., which grows abundantly in the southeastern region of Kazakhstan. Through this study, we identified the fundamental groups of biologically active compounds present in the plant. However, further exploration of its chemical composition and pharmacological properties is imperative for maximizing its potential in therapeutic and prophylactic drug development.

2 Materials and Methods

The collection and processing of plants adhered to Good Agricultural and Collection Practices (GACP) [9]. Aqueous extracts of the plants were prepared to assess the total quantitative content of polyphenols, flavonoids, and essential oils. A comprehensive phytochemical analysis of the biologically active substances (BAS) composition of the studied species was conducted using a modern suite of methods for analyzing the chemical composition of medicinal plants. The main quantitative composition of BAS groups in plant samples was determined in accordance with the methods outlined in the State Pharmacopoeia of the Republic of Kazakhstan and the International WHO Pharmacopoeia [10]. The total phenol content in the samples was determined spectrophotometrically using the method described by Spanos and Wrolstad [11]. Specifically, 100µl of the obtained sample was mixed with 900µl of deionized water, 4 ml of Na_2CO_4 solution (75g/l), and 5 ml of 0.2 N Ciocalteu's reagent. The mixture was then left in a dark environment for 2 hours before measuring its absorption at a wavelength of 765 nm using a spectrophotometric device (Shimadzu UV-Vis 160A, Japan).

3 Results and Discussion

Biologically active substances found in plants serve as crucial indicators of plant quality, shaping their properties and overall value. The quantity and quality of these compounds are influenced by a multitude of internal and external factors. Variations in geographical growth areas and climatic conditions can lead to a diverse array of chemical compounds within the same plant species, thereby shaping the properties and diversity of biologically active compounds.

The collected plant materials of *Artemisia schrenkiana* Ledeb. were carefully dried in shaded outdoor areas, ensuring purity and the absence of fungi, while quantitatively and qualitatively assessing factors such as humidity and the quantity of extractive substances.

Minerals play a vital role in both plant and human life, with their composition in medicinal plants estimated through ash content analysis. Research indicates that mineral content can range from 3-25% depending on the type of raw material. In the case of *Artemisia schrenkiana* Ledeb., analysis revealed an ash content of 5.7% and humidity of 5.36% in the above-ground parts of the plant. Furthermore, it was determined that the surface part of the plant contains essential compounds such as amino acids, carbohydrates, polyphenols, flavonoids, and carotenoids.

Table 1. Quantitative composition of biologically active compounds (quantitative composition, mg/g of dry matter).

Metabolites	Amount of BAS, %
Extractive substances	29,57±0,10
Amino acids	1,45±0,16
Coumarins	0,135±0,31
Carbohydrates	2,32±0,4
Flavonoids	3,8±0,11
Tannin	10,06±0,02
Alkaloids	1,0±0,31
Phenols	2,83±0,22

Extractives refer to the weight of the dry residue obtained by evaporating the dried powder of *Artemisia schrenkiana* Ledeb. individually with 80% ethanol alcohol. According to the research findings, this plant contained extractive substances at a concentration of 29.57%, along with amino acids at 1.45%. A total of 12 amino acids were identified in the extract of *Artemisia schrenkiana* Ledeb., of which 8 are considered essential amino acids. The quantities of amino acids determined in the plant extract using the capillary electrophoresis system "Capel 105M" are presented in Table 1 (chromatogram).

As depicted in Table 2, it can be observed that the content of non-essential amino acids, specifically leucine + isoleucine, is relatively high, at 190.0 mg/l. Additionally, arginine, histidine, methionine, and threonine were determined to be present at levels of 25.0 mg/l, 23.0 mg/l, 12.0 mg/l, and 15.0 mg/l, respectively. Among the 13 different amino acids identified, 8 types (leucine, isoleucine, lysine, methionine, threonine, phenylalanine, arginine, histidine) are considered non-essential amino acids.

Table 2. Number of amino acids determined in *Artemisia schrenkiana* Ledeb. plant extract.

No	Time	Component	Height	Start	End	Area	Conc.,mg/l	% of amino acids
1	6.198	arginine	0.505	6.167	6.233	22.02	25.0	0,103±0,041
2	8.522	lysine	0.157	8.483	8.563	3.495	1.70	0,007±0,002
3	8.652	tyrosine	0.102	8.570	8.697	3.948	4.10	0,017±0,005
4	9.025	phenylalanine	0.140	8.945	9.087	6.859	6.50	0,027±0,008
5	9.243	histidine	0.396	9.123	9.335	24.95	23.0	0,095±0,047
6	9.493	Leucine+ isoleucine	9.190	9.335	9.590	524.5	190.0	0,781±0,203
7	9.632	methionine	0.468	9.590	9.708	14.29	12.0	0,049±0,017
8	9.802	proline	0.198	9.708	9.838	8.101	5.00	0,021±0,005
9	9.893	threonine	0.711	9.843	9.967	22.44	15.0	0,062±0,025
10	10.237	serin	0.051	10.198	10.302	2.143	1.10	0,005±0,001
11	10.367	alanine	0.316	10.302	10.443	10.7	4.50	0,018±0,005
12	10.867	glycine	0.204	10.832	10.918	3.677	1.30	0,005±0,002

According to our research findings, *Artemisia schrenkiana* Ledeb. contains various compounds, including coumarins (0.135%), carbohydrates (2.32%), sucrose (0.30g/100g), fructose (11.02g/100g), and tannins (10.06%). Additionally, the plant exhibited a relatively low level of polyphenols (265.01±1.2mg GAE/g), while the total quantitative number of flavonoids, determined by standard colorimetric analysis, was notably high (142.1±2.1mg CAE/g). These findings highlight the significance of exploring indigenous medicinal plants like *Artemisia schrenkiana* Ledeb. for their therapeutic and prophylactic potential.

However, while our research provides valuable insights into the chemical composition and biological activities of *Artemisia schrenkiana* Ledeb., further studies are necessary to fully elucidate its mechanisms of action and to validate its clinical applications in modern medicine. Several phenolic compounds found in the plant possess beneficial properties such as anti-obesity, anti-diabetic, anti-inflammatory, and anti-cancer effects, attributed to their antioxidant properties [12,13].

Analyzing the activity of amino acids identified in *Artemisia schrenkiana* Ledeb., it is noteworthy that proline, a heterocyclic amino acid, plays a crucial role despite lacking diagnostic criteria for deficiency. Increased age often correlates with a higher need for amino acids like proline, and individuals with joint disease, poor skin health, and vascular risks may benefit from its supplementation. Lysine, an essential aliphatic amino acid, is vital for maintaining hormonal balance and producing immune cells. Serine, also essential, contributes significantly to brain cell and nerve membrane integrity, while supporting immune function. Valine, a natural anabolic amino acid, plays a role in muscle metabolism, regeneration, and nitrogen balance. Its inclusion in the diet can enhance muscle coordination, reduce sensitivity to pain, heat, and cold, and help maintain serotonin levels in the body.

4 Conclusion

In conclusion, The medicinal properties and pharmacological mechanism of action of medicinal plants depend to a large extent on the type and quantity of biologically active substances contained in them. *Artemisia schrenkiana* Ledeb. emerges as a significant medicinal plant, particularly in the context of the domestic flora of Kazakhstan. Through comprehensive phytochemical analysis, it has been revealed to contain a rich array of biologically active compounds, including extractive substances, coumarins, carbohydrates, tannins, amino acids, flavonoids, and phenolic compounds. They are antioxidants for the protection of oxidative damage to crucial biomolecules (DNA, lipid, and protein) involved in numerous diseases.

Furthermore, these compounds contribute to its pharmacological properties, which encompass anti-inflammatory, antimicrobial, anticancer, hypoglycemic, hypocholesterolemic, antibacterial, antifungal, antiviral activity, and analgesic activities and anticancer activities. Therefore, this plant would be an important candidate in pharmaceutical formulations and play an important role in improving the human health by participating in the antioxidant defense system against.

Overall, *Artemisia schrenkiana* Ledeb. represents a promising avenue for the development of novel therapeutic and preventive drugs, offering potential solutions for addressing various health challenges. Continued investigation into this plant species holds the promise of uncovering new avenues for drug discovery and development, ultimately benefiting both traditional and modern healthcare systems.

Acknowledgments

The research was carried out at the expense of a grant from the Committee of Science, Ministry of Science and Higher Education, Republic of Kazakhstan (grant IRN AP13067924).

Authors' contribution

S.S. methodology and software; G.A. formal Analysis and resources; A.Y. writing – original draft preparation, writing – review & editing, and supervision.

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