Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2025, 31 (4), 445-451

Journal of Agroalimentary Processes and Technologies

A Comparatıve Perspectıve between *Chenopodıum Album* and *Atrıplex Hortensıs*: Perceptıon and Nutrıtıonal Value

Mihaela Lăcătuș[1,2], Petruța-Elisabeta Andrei[1,2], Mariana-Atena Poiană[1,2]*, Despina-Maria Bordean[1,2]

[1]*Faculty of Food Engineering, University of Life Sciences "King Mihai I" from Timisoara, 300645 Timisoara, Calea Aradului Street 119, Romania*

[2] *Food Science Research Center, University of Life Sciences "King Mihai I" from Timisoara, 300645 Timisoara, Calea Aradului Street 119, Romania*

**Corresponding author: marianapoiana@usvt.ro*

Abstract

Traditional leafy plants have been from a long times part of local diets, appreciated for their adaptability and rich nutritional profiles. The aim of this study is to compare the nutritional importance of *Atriplex hortensis* and *Chenopodium album*, due to their high mineral content. The paper highlights how these species differ in nutritional profiles but also how they have been used over time in human food. The investigation showed that *Atriplex hortensis* stands out for its higher protein and antioxidant content, while *Chenopodium album* offers higher amounts of vitamin C, minerals and fiber. In terms of tradition, both species were used as supplementary food sources. *Atriplex hortensis* was more commonly cultivated, while *Chenopodium album* usually grew wild and was gathered from spontaneous vegetation. Recent findings emphasize that both plants could play a meaningful role in contemporary nutrition, as locally available and nutrient-dense foods that may help enrich the diet and support a balanced, healthy lifestyle.

Keywords: plant diversity, functional value, nutritional sustainability, traditional use

1. Introduction

In a time when food availability, climate change, and environmental degradation are becoming increasingly evident, traditional or spontaneous plants with high nutritional value are once again gaining the attention of researchers in the fields of botany and nutrition [1,2]. Diversifying food sources and maximizing local resources is an effective way to increase the capacity of food systems and human diets. Among the plants that stand out for these advantages are *Atriplex hortensis* (orach) and *Chenopodium album* (lambsquarters), species that combine a long tradition of consumption with a valuable nutritional profile and a high capacity to adapt to different environmental conditions [3,4].

1.1 Origins, spread and adaptability

Atriplex hortensis is an annual plant native to Eurasian regions, valued for its resistance to salinity, temperature variations and drought periods. Recent genomic research highlights a remarkable capacity to adapt to diverse ecological conditions, including marginal lands, degraded soils or areas with salt accumulation [5]. A study published in Frontiers, titled "A Chromosome-Scale Assembly of the Garden Orach (*Atriplex hortensis L.*)" [6], shows that both the leaves and seeds of this plant are edible. The leaves have a high protein content — about 35% of the dry mass — comparable to or even higher than that found in other leafy vegetables, such as spinach [6]. *Chenopodium album* is a species that has always grown spontaneously and has spread widely in the wild flora, being frequently found in fields, roadsides or disturbed lands. It has no special cultivation requirements, which makes it easy to exploit on, especially in rural communities or in areas with limited resources. Over generations, the plant has been used as an edible green, its young leaves being appreciated both for their pleasant taste and for their nutritional value [4].

1.2. Nutritional and bioactive composition

Betalain pigments, notably celosianin and

DOI: 10.59463/JAPT.2025.4.7

amaranthine, are a defining trait of the red forms of *Atriplex hortensis* (var. rubra). Recent studies have paid close attention to these molecules because of their antioxidant and anti-inflammatory actions. Leaf and seed extracts from red *A. hortensis* have shown in vitro capacity to dampen inflammatory responses and protect cells, without causing appreciable cytotoxicity [7]. When identical extraction procedures are applied, *Atriplex hortensis* tends to yield more total phenolics and flavonoids than *Chenopodium album*. Similar analyses using the ABTS method also report higher radical-scavenging activity for *A. hortensis*, suggesting a stronger ability to neutralize ABTS-type free radicals [8]. On the other hand, *Chenopodium album* stands out for its consistent nutritional profile, characterized by a high content of vitamin C (over 150 mg/100 g, according to some research), as well as by the presence of significant amounts of carotenoids, essential minerals (Ca, Fe, Zn, Mn) and dietary fiber. Analyses carried out on young leaves of *C. album* from southwestern Spain indicated values of approximately 155 mg of vitamin C and 12.5 mg of carotenoids per 100 g of fresh product, which confirms its high potential as a nutritional vegetable source [9].

1.3. Antinutrients and limitations

Both *Atriplex hortensis* and *Chenopodium album* have certain limitations that may influence their food use, especially if appropriate processing measures are not applied. *A. hortensis* seeds naturally contain saponins that can make them bitter and in higher amounts are potentially dangerous. Saponins can be reduced or even eliminated by washing or through various processing treatments. Also, differences between varieties, maturity stage, soil type and climatic conditions can cause significant variations in nutrient and antinutrient content [10].

Some studies have identified certain natural compounds in *C. album* - oxalates, phytates and other antinutritional factors. These compounds may limit mineral absorption or cause digestive discomfort when consumed in large quantities. Fortunately, these effects can be minimized through simple culinary or processing steps, including boiling with water replacement, drying, or using young leaves, which naturally contain lower concentrations of such compounds [9,11].

1.4. Traditional and cultural use

The use of the species *Chenopodium album* is well documented both in folk tradition and in agricultural and gastronomic practices. The young leaves were often used in soups, salads or as side dishes, being cooked in a similar way to spinach, and the seeds were sometimes mixed into flours or used as an alternative source of starch. Over the years, this plant has come to be appreciated not only as an alternative source of nourishment but also as a valuable addition to traditional rural diets, offering extra nutritional benefits and supporting dietary diversity. At the same time, the ethnobotanical literature mentions various medicinal uses, *Chenopodium album* being associated with anti-infective, hepatoprotective, antioxidant, antidiabetic and other beneficial effects on health [12]. In the case of *A. hortensis*, tradition has meant, on the one hand, its cultivation in home gardens and the use of the leaves as greens. The varieties with red leaves were appreciated not only for their taste, but also for their color. In some regions, the plant also had medicinal uses or as a food supplement, and was also used to stabilize soils or improve those with high salinity [5,13].

1.5. Consumer perception and social status of plants

The attitude towards food plants considered "non-conventional", such as *C. album*, is often ambivalent. On the one hand, they are appreciated for their taste and nutritional value; on the other hand, there is reluctance due to the perception of "wild weeds", fears of contamination, bitter taste, unpleasant texture or the presence of anti-nutrient compounds [12]. Similarly, *A. hortensis*, due to its greater frequency of cultivation, is often associated with "noble" garden vegetables, being perceived as safer and more consistent in quality. Varieties with red leaves contribute to visual appeal and enhance the impression of freshness and health. From the information available in the literature, awareness of the antioxidant properties of the plant has favored its revalorization in local markets, in specialized gardening and in organic farming [14,15].

1.6. Potential for modern use

Studies show that *A. hortensis* has great potential not only as a vegetable but also as a source of high-quality vegetable protein, with an essential amino acid profile close to FAO/WHO recommendations [16]. Both the leaves and seeds of the plant could contribute to filling protein deficiencies in regions where leafy vegetables are scarce or expensive. In addition, the ability of this species to adapt to marginal lands, saline soils or semi-arid areas recommends it for sustainable agricultural practices and crop diversification [17]. *C. album*, through its spontaneous availability and immediate ease of use, offers the advantage of being consumed without the

need for sowing or intensive care, which makes it particularly suitable for rural communities or for periods of food shortage. The use of this plant as a supplementary vegetable, rich in vitamins and minerals, can be integrated into community nutrition programs, food education or urban horticulture. Based on these characteristics, the research reveals how these plants have traditionally been used in local diets and how they are currently perceived in terms of taste, usefulness, and safety. It also aims to explore both the benefits and the limitations of including them in modern nutrition, with attention to sustainability and public health.

This study offers multiple level answers regarding development of practical recommendations for growing, processing, and preparing these plants in ways that enhance their nutritional value while minimizing possible risks; it supports communities that still use or could reintroduce these species into their diet; helps reduce dependence on costly or less accessible conventional vegetables, and promotes the cultivation of resilient crops in areas with limited agricultural resources.

2. Materials and method

2.1. Data Sources and Collection

The present study was based on literature from different database and scientific articles data that reported the nutritional composition and mineral content of *Chenopodium album* and *Atriplex hortensis*. Only studies providing quantitative and comparable data were selected for analysis.

2.2. Data Processing and Comparative Evaluation

From each reference, available parameters (proteins, total fat, carbohydrates, fiber, ash, Ca, K, Mg, P, Na, Fe, Zn, Cu, Mn, etc.) were collected, specifying the plant part analyzed (leaves and seeds). Values were converted to uniform units (mg/100 g, g/100 g fresh weight) to ensure comparability.

The collected data were submitted to statistical analysis and modeling using MVSP software (version 3.22) to explore possible correlations and patterns among the studied parameters.

3. Results and Discussion

To explore the main research objectives, data collected from scientific literature and database sources were organized into a comparative table (Table 1) and analyzed through several graphical representations (Figures 1–3). These visual tools provided a clearer understanding of the nutritional composition and mineral variability between *Chenopodium album* and *Atriplex hortensis*.

A general overview presented in Figure 1, offers a general overview of how nutrients are distributed, revealing distinct differences in both macronutrient and mineral content. *Atriplex hortensis* shows notably higher amounts of elements, while *Chenopodium album* presents a more even balance of other key nutrients. Figure 2 expresses these values as relative percentages, allowing a clearer comparison of proportions and highlighting how the two species vary in composition depending on the plant part analyzed and the reference source.

The cluster analysis is presented in Figure 3, showing how nutritional and mineral parameters naturally group together, reflecting patterns of similarity and connection among the studied variables. Taken together, these visual insights provide a comprehensive understanding of the nutritional profiles of both plants and emphasize their potential valuea as complementary food resources.

Table 1 reveals that *Atriplex hortensis* shows higher mineral concentrations than *Chenopodium album*: potassium (up to 2.9 g/100 g), phosphorus (up to 420 mg/100 g), calcium (0.67–2.00 g/100 g), and magnesium (0.36–0.50 g/100 g) levels were noticeably higher in *A. hortensis* samples. In contrast, *C. album* displayed slightly greater carbohydrate (7.0 g/100 g) and moisture contents (76.7%), indicating a more hydrated and energy-oriented profile. Protein values diverse widely, with *A. hortensis* reaching up to 17 g/100 g in some reports, while *C. album* maintained moderate levels around 4.2 g/100 g. Overall, *A. hortensis* can be considered mineral-dense, while *C. album* contributes more to hydration and carbohydrate balance.

Table 1. Nutrients analysis in seeds and leaves of *Atriplex hortensis* and *Chenopodium album* for 100 g F.W.

Components	Symbols	MU	C.alb.R.L. [18]	A.hort.R.L. [19]	A.hort.R.L. [20]	A.hort.R.L. [21]	A.hort.R.L. [21]	A.hort.S. [2]	C.alb.S. [22]
Water	H2O	%	76.700	90.100	-	-	-	4.580	-
Energy	Kcal	kcal	47.000	184.000	-	-	-	-	-
Protein	Prot	g	4.220	2.970	17.000	-	-	13.205	-
Total fat lipid	TotF	g	0.333	0.750	3.000	-	-	3.315	-
Ash	Ash	g	0.030	3.710	24.000	-	-	1.635	-
Carbohydrate	Carbh	g	7.000	2.470	56.000	-	-	28.385	-
Total dietary fiber	TotDF	g	6.330	3.770	11.000	-	-	6.385	-
Calcium	Ca	g	0.365	0.678	2.000	0.590	0.666	-	0.009
Iron	Fe	mg	1.111	8.770	10.000	6.348	7.773	-	5.665
Magnesium	Mg	g	0.163	0.389	0.500	0.356	0.356	-	0.080
Phosphorus	P	mg	63.000	158.000	150.000	268.289	419.711	-	-
Potassium	K	g	1.266	0.421	0.800	2.121	2.9	-	0.506
Natrium	Na	mg	7.000	-	-	630.347	672.675	-	4.144
Zinc	Zn	mg	0.667	8.500	-	2.687	2.825	-	1.222
Copper	Cu	mg	0.111	-	2.000	1.075	1.003	-	0.313
Manganese	Mn	mg	0.000	-	10.000	3.425	2.170	-	-

Legend: A.hort. R.L.= Atriplex hortensis raw leaves; C.alb. R.L. = Chenopodium album raw leaves; A.hort.S.= Atriplex hortensis seeds; C.alb.S.= Chenopodium album seeds.

Figure 1 highlights significant differences in the nutritional and mineral composition between *Chenopodium album* and *Atriplex hortensis*. Noticeably, *Atriplex hortensis* shows a higher variability in mineral content, especially for potassium (K) and phosphorus (P), which appear in much greater concentrations than in *Chenopodium album*. These differences can be influenced by the environment in which they grew and develop, the plant parts that were analyzed, and the methods used for determination.

The water and carbohydrate content present in *Chenopodium album* is higher, suggesting a lower accumulation of dry matter. The energy values also differ significantly, resulting in compositional diversity between sources, possibly also different stages of maturity or soil conditions.

The comparative presentation of the proportional distribution is represented in Figure 2. It clearly shows that *Chenopodium album* maintains a constant lead in terms of water and energy content, while *Atriplex hortensis* shows a greater difference between minerals, especially for magnesium (Mg), potassium (K) and phosphorus (P).

The unequal distribution seen in the colored areas indicate that nutrient composition vary significantly depending on plant part. This pattern specify that *Atriplex hortensis* may adapt its mineral profile more strongly to environmental conditions, while *Chenopodium album* tends to remain more uniform in composition.

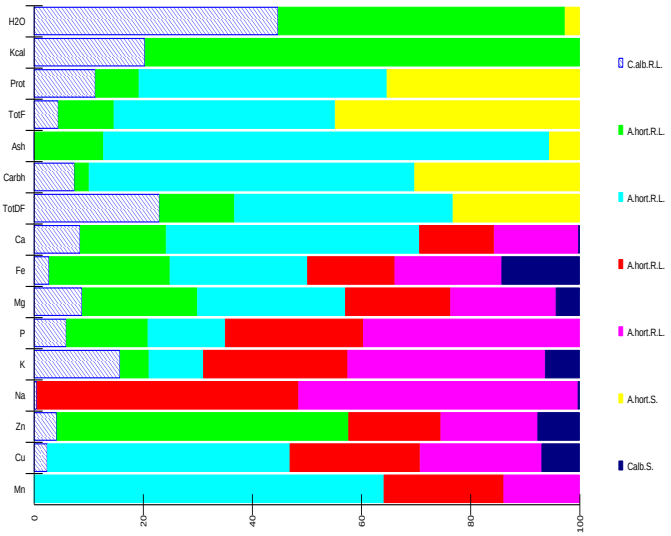

Figure 1. Comparative differences in the nutritional and mineral composition between *Chenopodium album* and *Atriplex hortensis*

Legend: C.alb.R.L.= Chenopodium album raw leaves; A.hort.R.L.= Atriplex hortensis raw leaves; A.hort.S.= Atriplex hortensis seeds; C.alb.S.= Chenopodium album seeds; H2O = Water; Kcal = Energy; Prot = Protein; TotF = Total fat lipid; Ash = Ash; Carbh = Carbohydrate; TotDF = Total dietary fiber; Ca = Calcium; Fe = Iron; Mg = Magnesium; P = Phosphorus; K = Potassium; Na = Natrium; Zn = Zinc; Cu = Copper; Mn = Manganese.

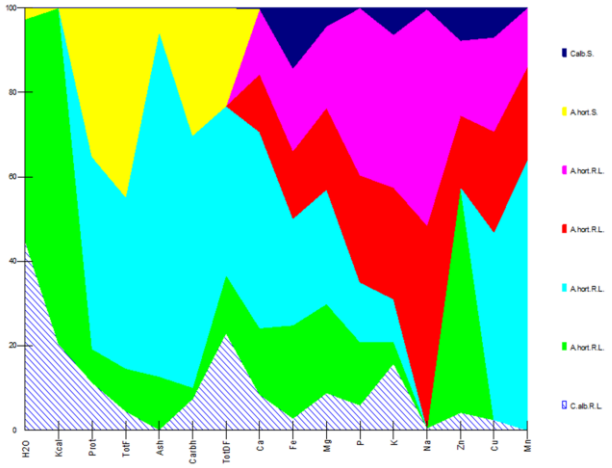

Figure 2. Distribution of macro- and microelements among *Atriplex hortensis* and *Chenopodium album*
Legend: C.alb.R.L.= Chenopodium album raw leaves; A.hort.R.L.= Atriplex hortensis raw leaves; A.hort.S.= Atriplex hortensis seeds; C.alb.S.= Chenopodium album seeds; H2O = Water; Kcal = Energy; Prot = Protein; TotF = Total fat lipid; Ash = Ash; Carbh = Carbohydrate; TotDF = Total dietary fiber; Ca = Calcium; Fe = Iron; Mg = Magnesium; P = Phosphorus; K = Potassium; Na = Natrium; Zn = Zinc; Cu = Copper; Mn = Manganese.

Considerable variations can be observed between sodium (Na) and potassium (K) content. C.alb.R.L. stands out for its very high level of sodium, compared to the other samples, indicating a possible accumulation specific to the species or growing conditions. In contrast, the samples from the A.hort series show more balanced values for most parameters.

On the axes representing proteins (Prot), carbohydrates (Carbh) and total fibers (TotDF), the differences between the samples are smaller, suggesting a relatively constant nutritional composition between these species. However, the slightly higher values for A.hort.R.L. may indicate a richer content in proteins and fibers, qualities that can be considered beneficial from a nutritional point of view.

Regarding water (H2O) and ash (Ash) content, the variations are modest, suggesting a close similarity in structural composition and mineral content between the samples.

Figure 3 illustrates how the analyzed parameters naturally cluster based on their similarities, revealing clear patterns and relationships among the nutritional and mineral elements. Minerals like potassium, magnesium, calcium, and copper appear closely associated, hinting at a shared accumulation pattern within the studied species. On the other hand, water content and energy values form a separate group, showing an opposite trend to the mineral cluster — likely due to dilution effects, where higher moisture levels correspond to lower concentrations of solid nutrients. Phosphorus and sodium are positioned separately, showing independent distribution patterns that differentiate them from the rest of the dataset.

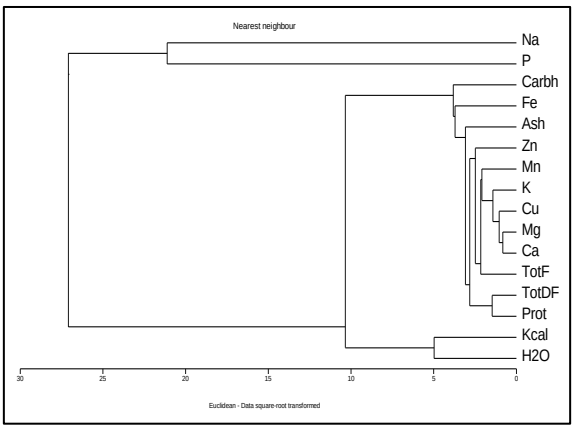

Figure 3. Compositional similarities among nutritional factors based on cluster analysis
Legend: H2O = Water; Kcal = Energy; Prot = Protein; TotF = Total fat lipid; Ash = Ash; Carbh = Carbohydrate; TotDF = Total dietary fiber; Ca = Calcium; Fe = Iron; Mg = Magnesium; P = Phosphorus; K = Potassium; Na = Natrium; Zn = Zinc; Cu = Copper; Mn = Manganese.

Regarding the consumer perception and social status of plants, the alternatives "often highlights health and sustainability benefits" [23], while the barriers might include "negative perceptions of taste, texture, and familiarity, leading to lower acceptance rates" [23].

At the same time the traditional uses are recommended to be reimagined in order to obtain innovative or eco-friendly products, but due to the resistence to change specifically to such products and the reduced knowledge might hinder their acceptance in the modern consumer market.

4. Conclusion

The comparative evaluation shows that *Chenopodium album* and *Atriplex hortensis* each bring distinct nutritional advantages. *Atriplex hortensis* tends to be richer in minerals, especially potassium, magnesium, and calcium, key elements that help maintain metabolic balance, bone strength, and overall vitality. In contrast, *Chenopodium album*

offers a steadier supply of carbohydrates and moisture, making it an important source of energy and hydration, particularly in plant-based diets.

Taken together, the two species complement one another nutritionally. Using them in combination could create a more complete dietary profile, where the higher mineral content of *A. hortensis* balances the energy contribution of *C. album*. This synergy could be especially valuable for developing functional foods designed to support both nutrition and wellness.

Beyond their nutrient composition, both plants stand out for their adaptability and availability, fitting perfectly within the goals of sustainable and locally focused nutrition. Bringing these traditional species back into modern food practices could help diversify diets while promoting environmentally conscious food production and resilient regional agriculture.

In essence, *Chenopodium album* and *Atriplex hortensis* represent overlooked yet highly promising plants, whose complementary qualities could contribute meaningfully to the creation of healthier and more sustainable eating models rooted in local biodiversity.

Although the current study focuses primarily on the nutritional and mineral composition, it is important to acknowledge the role of antinutritional compounds (oxalates, phytates, and saponins) which can influence nutrient bioavailability and overall dietary safety. Existing literature provides only limited data on their concentrations in *Chenopodium album* and *Atriplex hortensis*. Therefore, future research should aim to quantify these compounds under different growth and processing conditions, to better assess their impact and develop effective strategies—such as thermal treatment or fermentation—to minimize their negative effects while preserving the plants' nutritional benefits.

Acknowledgments This study was funded by the University of Life Sciences "King Mihai I" from Timisoara" and the results will be included in the PhD Thesis of Mihaela Lăcătuș.

Conflicts of interest / Competing interests: No conflict of interest

Ethics approval: No ethic situation.

Availability of data and material: The data have been reviewed depending on the literature.

References

1. Kachout, S. S., Dhane, S., BenYoussef, S., Tlili, A., Douili, M., Guesmi, F., & Zoghlami, A. Sustainable phytoremediation of saline soils using Atriplex hortensis L.: a case study from Bizerte Lagoon, Northern Tunisia. *Frontiers in Plant Science*, **2025.** 16, 1613594. https://doi.org/10.3389/fpls.2025.1613594
2. Wright, K. H., Pike, O. A., Fairbanks, D. J., & Huber, C. S. Composition of Atriplex hortensis, sweet and bitter Chenopodium quinoa seeds. *Journal of food science*, **2002**. 67(4), 1383-1385. https://doi.org/10.1111/j.1365-2621.2002.tb10294.x
3. Qadir, M., Oster, J. D., Schubert, S., Noble, A. D., & Sahrawat, K. L. Phytoremediation of sodic and saline-sodic soils. *Advances in agronomy*, **2007.** 96, 197-247. https://doi.org/10.1016/S0065-2113(07)96006-X
4. Singh, S., Singh, A., Hallan, S. S., Brangule, A., Kumar, B., & Bhatia, R. A compiled update on nutrition, phytochemicals, processing effects, analytical testing and health effects of Chenopodium album: a non-conventional edible plant (NCEP). *Molecules*, **2023,** 28(13), 4902. https://doi.org/10.3390/molecules28134902
5. Tanaka, Y., Sasaki, N., & Ohmiya, A. Biosynthesis of plant pigments: anthocyanins, betalains and carotenoids. *The Plant Journal*, **2008,** 54(4), 733-749. https://doi.org/10.1111/j.1365-313X.2008.03447.x
6. Hunt, S. P., Jarvis, D. E., Larsen, D. J., Mosyakin, S. L., Kolano, B. A., Jackson, E. W., ... & Maughan, P. J. A chromosome-scale assembly of the garden orach (Atriplex hortensis L.) genome using Oxford Nanopore sequencing. *Frontiers in plant science*, **2020,** 11, 624. https://doi.org/10.3389/fpls.2020.00624
7. Kumorkiewicz-Jamro, A., Górska, R., Krok-Borkowicz, M., Reczyńska-Kolman, K., Mielczarek, P., Popenda, Ł., ... & Wybraniec, S. Betalains isolated from underexploited wild plant Atriplex hortensis var. rubra L. exert antioxidant and cardioprotective activity against H9c2 cells. *Food Chemistry*, **2023** 414, 135641. https://doi.org/10.1016/j.foodchem.2023.135641
8. Kachout, S. S., Mansoura, A. B., Leclerc, J. C., Jaffel, K., Rejeb, M. N., & Ouerghi, Z. Effects of heavy metals on antioxidant activities of Atriplex hortensis and Atriplex rosea. *Journal of Applied Botany and Food Quality*, **2009.** 83(1), 37-43. https://www.cabidigitallibrary.org/doi/full/10.5555/20103040876
9. Guerrero, J. L. G., & Torija Isasa, M. E. Nutritional composition of leaves of Chenopodium species (*C. album L., C. murale L. and C. opulifolium Shraeder). International journal of food sciences and nutrition*, **1997,** 48(5), 321-327. https://doi.org/10.3109/09637489709028578

10. Jarvis, D. E., Ho, Y. S., Lightfoot, D. J., Schmöckel, S. M., Li, B., Borm, T. J., Tester, M. The genome of Chenopodium quinoa. *Nature*, **2017,** 542(7641), 307-312. https://doi.org/10.1038/nature21370
11. Savage, G., & Vanhanen, L. Oxalate contents of raw, boiled, wok-fried and pesto and juice made from fat hen (Chenopodium album) leaves, *Foods*, **2018** 8(1), 2. https://doi.org/10.3390/foods8010002
12. Majumdar, A., Saraf, S. K., & Sahu, C. Chemical Diversity and Health-Promoting Attributes of Chenopodium album: Nutritional and Pharmacological Perspectives. *Chemistry & Biodiversity*, **2025,** 22(9), e202403456. https://pubmed.ncbi.nlm.nih.gov/40265310/ DOI: 10.1002/cbdv.202403456
13. V., Phour, M., & Kumar, B.. Morphological characterization of indigenous vegetable ('Atriplex hortensis' L.) from trans-Himalayan region of Ladakh (Jammu and Kashmir), India. *Australian Journal of Crop Science*, **2017**, 11(3). https://www.cabidigitallibrary.org/doi/full/10.5555/20173376865 DOI: 10.21475/ajcs.17.11.03.pne261
14. https://superfoodly.com/atriplex-hortensis-medicinal-uses-of-the-garden-orache/?utm (Accessed in 14.10.2025)
15. Težak Damijanić, A., Čehić Marić, A., & Oplanić, M. Psychological Factors Influencing Willingness to Purchase Wild–Edible Plants and Food Products from Wild–Edible Plants. *Agriculture*, **2024** 14(11), 1856. https://doi.org/10.3390/agriculture14111856
16. Wright, K. H., Pike, O. A., Fairbanks, D. J., and Huber, C. S. Composition of Atriplex hortensis, sweet and bitter Chenopodium quinoa seeds. *J. Food Sci.* **2002,** 67, 1383–1385. https://doi.org/10.1111/j.1365-2621.2002.tb10294.x
17. Rinchen, T., & Singh, N. Exploring nutritional potential of Atriplex hortensis. *Indian Horticulture*, **2015,** 60(2). https://epubs.icar.org.in/ejournal/index.php/IndHort/article/view/52032/0?utm
18. Lăcătuș, M., Tarkanyi, P., Poiană, M. A., & Bordean, D. M. A comprehensive review of Amaranthus spp. as a nutrient-dense food supplement: focus on mineral composition and health benefits. *Journal of Agroalimentary Process and Technologies*., **2024** (30)(3), 320–328. https://journal-of-agroalimentary.ro/admin/articole/74757L14-30-3_JAPT20241042-LACATUS-DOI-29-pp-320-328.pdf https://doi. org/10.59463/japt, 29
19. Deepthi, K. V. Development of Soup-mix from Garden Orache (Atriplex Hortensis L.) (Doctoral dissertation, University of Agricultural Sciences, GKVK, Bangalore). **2023,** https://krishikosh.egranth.ac.in/server/api/core/bitstreams/cf49a009-b525-443f-824a-8a8ceefe19a1/content
20. Rinchen, T., & Singh, N. Exploring nutritional potential of Atriplex hortensis. *Indian Horticulture*, **2015,** 60(2). (PDF) Exploring Nutritional potential of Atriplex hortensis. https://www.researchgate.net/profile/Tsewang-Rinchen/publication/315772838_Exploring_Nutritional_potential_of_Atriplex_hortensis/links/58e3baa6458515e7ab64427a/Exploring-Nutritional-potential-of-Atriplex-hortensis.pdf
21. Uslu, N., Acar, R., Seymen, M., Dursun, N., Türkmen, Ö., & Özcan, M. M. The effect of sowing dates on total phenol, antioxidant activity and phenolic compounds of orache garden leaves harvested from plants growing garden house and field conditions. *Journal of Agroalimentary Processes & Technologies*, **2020,** 26(4). https://doi.org/10.1094/CCHEM.2002.79.5.715
22. Jan, R., Saxena, D. C., & Singh, S., Comparative study of raw and germinated Chenopodium (Chenopodium album) flour on the basis of thermal, rheological, minerals, fatty acid profile and phytocomponents. *Food Chemistry*, **2018.** 269, 173-180. https://doi.org/10.1016/j.foodchem.2018.07.003
23. Giacalone, D., Clausen, M. P., & Jaeger, S. R. Understanding barriers to consumption of plant-based foods and beverages: Insights from sensory and consumer science. *Current Opinion in Food Science*, **2022,** 48, 100919. https://doi.org/10.1016/j.cofs.2022.100919