

## Taxa belonging to the *Chenopodium* Genus preserved in the "Alexandru Beldie" Herbarium

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**Abstract** The *Chenopodium* Genus includes varieties of species widely spreaded in East of Mediterranean region, but most of the them are native from Asia, China, Europe, India and both North and South America. Popularly, the erbaceous plants with flowers are called "goosefoots", having annual or perennial cycle. In some continents, several species were domesticated and highly valued for the presence of amino acids located in the seeds and the richness of mineral and vitamin from their foliage apparatus. Often, plants were used in commercial strategies as spices or even drugs, because of the metabolites constituents (flavonols, essential oils, terpenes). The species from *Chenopodium* Genus are adapted to survive even in ecological niches with harsh environmental conditions due to the presence of stress-response mechanisms. In Romania, the presence of plants from *Chenopodium* Genus completes the collection of "Alexandru Beldie" Herbarium within "Marin Drăcea" National Institute for Research and Development in Forestry through an high number of plates (vouchers), as well as the collected data regarding on the harvesting periods and locations, botanists involved in the process of harvesting, as well as the estimated degree of conservation for each taxa. The present paper exposes the most representative taxa of *Chenopodium* Genus preserved in "Al.Beldie" Herbarium. Furthermore, the article highlights some morphology particularities and some curiosities about traditional uses, biological activities and so on. As material, it was used the collected plates which contained the conserved plants. Whole of the characteristics discovered were centralized into a database. As method, it was built a systematic analysis for describing the collection: drawer number, plate number, harvesting date and location, degree of conservation and the botanist who gathered the plants. Regarding on the inventory of plants from *Chenopodium* Genus preserved in "Al. Beldie" Herbarium, 109 plates were identified, with 27 taxa, the most representative being *Chenopodium album* L. (29 plates), *Chenopodium botrys* L. (9 plates), *Chenopodium urbicum* L. (7 plates), *Chenopodium opulifolium* Schrad (6 plates), *Chenopodium hybridum* L., *Chenopodium ambrosioides* L. (4 plates). The final part emphasize conclusions with the actual contribution of plants from *Chenopodium* genus hosted in this spectacular herbarium and their remarkable characteristics.

### Key words

botanists, *Chenopodium* Genus, harvesting, plates, taxa

Designed in 1929, the "Alexandru Beldie" Herbarium owned by the "Marin Drăcea" National Institute of Research and Development from Bucharest currently contains about 60,000 plates, of which 40,000 well-preserved, belonging to species of herbaceous plants, morphological parts of trees and shrubs. The herbarium has a special historical value and consists of 30 modules, each module being equipped with 20 drawers. It was included in the Index Herbariorum, being inscribed with a BUCF International Code [8, 27, 28, 18]. More than 200 taxa from the *Chenopodium* genus are herbaceous plants that come from Asia, China, Europe, India, North and South America [25]. Plants of the *Chenopodium* genus, included in the

family *Chenopodiaceae* have been intensely exploited as spices or drugs in the East Mediterranean area, due to the rich content of metabolites in tissues. The most important compounds are essential oils, flavonoids and terpenes [1, 19, 20, 13]. The leaves of plants of the *Chenopodium* Genus have the ability to accumulate large amounts of heavy metals (Cu, Cr, Cd, Ni, Zn) in tissues, even at lower concentrations in the soil [3]. The common name of plants from *Chenopodium* Genus is 'goosefoot', due to the shape of the leaf. Traditionally, many parts of this plant have been used as a treatment for dysfunctions [2]. *Chenopodium* Genus had different implications in phytochemistry, ethnopharmacology and pharmacology [17]. In Ayurveda, India, there are

about 21 species belonging to this genus used successfully in the establishment of agricultural crops or grasses as well as in treating diseases of the body such as: cough, abdominal pain, nervous affection and so on [30].

Many herbs belonging to this genus contain essential oils in the leaves such as  $\alpha$ -terpinene, p-lymene, limonene, terin-1-ol, dyhydroascaridole, cis-ascaridole, cis- isoascaridole, tymol, carvacrol [7]. "Alexandru Beldie" Herbarium is an important segment of botany, which currently hosts species belonging to the following genera: 11 species of *Elymus* genus [22], 42 species of *Alnus* genus [11], 65 species of *Rubus* genus [9], 25 species of *Asperula* genus [23], 17 species of *Amaranthus* genus [10], 29 species of *Allysum* genus [6], 58 species of *Cornus* genus [29], 36 species of *Bromus* genus [27], 130 species of *Campanula* genus [12], 30 species of *Arenaria* genus [28]. The aim of the study was to identify the taxa belonging of *Chenopodium* Genus preserved in Al. Beldie Herbarium collected from different points of the world.

## Material and Method

This article provides information on superior plants belonging to the *Chenopodium* genus, preserved in optimal conditions in the collection of plants inscribed in the herbarium of the famous botanist Alexandru Beldie. As research materials, maps with taxa belonging to this genus were used. The plates with the plants harvested by numerous specialists were extracted from the maps. Each plate has inscriptions on the labels, being subsequently checked.

The information refers to: species and variety, harvesting place, the specialist who harvested the plant, as well as the degree of conservation of the plant. The working method consists in creating databases often comprising simple tables with updated and much more extensive information. The following fields are entered in the tables: drawer number, plate number, herbarium / botanical collection / institution from which the taxon / plant comes, name of the species, date and place of collecting, the specialist who collected / determined the species and the degree of conservation. Regarding the degree of conservation, it was coded with Arabic numbers from 1 to 4, symbolizing the way in which the taxonomic and morphological characters of the plants were preserved, as follows: number 1-well-preserved plant, correctly attached to the plate, whole; number 2-plant detached from the plate, which shows detached but existing parts; number 3- plant detached from the plate, with many parts missing; number 4- detached, fragmented plant, with over 50% missing parts. This herbarium contains useful databases for the study of biodiversity and the range of species, new types of forest habitats or can be used successfully in research based on the usage of parameters gathered in molecular biology.

## Results and Discussions

Following the inventory process (table 1), 109 plates with a number of 46 taxa belonging to analyzed *Chenopodium* Genus were identified: *Chenopodium foliosum* (*Blitum virgatum* L), *C. urbicum* L, *C. urbicum* L ssp rhombifolium, *C. ambrosioides* L, *C. intermedium*, *C. botrys* L, *C. murale* L, *C. acutifolium*, *C. hybridum* L, *C. opulifolium* Schrad, *C. opulifolium* Schrad var. typicum f mucronulatum Beck, *C. polyspermum* L, *C. polyspermum* var. acutifolium Beck, *C. olidum* Curtis, *C. ficifolium* Sm, *C. bonus-henricus* L, *C. anthelminticum* L, *C. wolffii* Simonk, *C. album* L, *C. album* L ssp album, *C. album* L ssp viride Wahl, *C. album* L ssp geminum Beck, *C. album* L ssp spicatum, *C. album* L ssp spicatum koch, *C. album* L preacutum Beck, *C. album* L ssp spicatum Nyar var praeacutum Beck f subhastatum Kras, *C. album* L ssp hastatum, *C. album* L ssp spicatum Nyar var praeacutum Beck, *C. album* L ssp hastatum Murr, *C. album* L ssp spicatum Nyar linnaeanum Beck, *C. album* L ssp Viride Nyar, *C. album* L var subficifolium Murr, *C. album* L ssp album v candicans Lam, *C. strictum* Roth, *C. strictum* Roth f pseudo-Borbassii Beck, *C. vulvaria* L, *C. capitatum* L, *C. virgatum*, *C. glaucum* L, *C. glaucum* L f prostratum Beck, *C. rubrum* L, *C. crassifolium* var. degenianum Aellen var. lengyelianum Aellen, *C. striatum*, *C. pseudostriatum* Zschacke, *C. multifidum* L, *C. chilense* Schrad.

From those 109 plates, the most belong to the following species: 29 plates with *Chenopodium album* ssp., from which 13 plates with *C. album* L, covering a total number of 15 taxa (32%), 9 plates with *Chenopodium botrys* L, 7 plates with *Chenopodium urbicum* L. (2 plates with *Chenopodium urbicum* L ssp rhombifolium), 6 plates with *Chenopodium opulifolium* Schrad (one plate with *C. opulifolium* var typicum f mucronulatum Beck) and 6 plates with *Chenopodium polyspermum* L. (2 plates containing *C. polyspermum* var. acutifolium Beck).

The recognition of the species is easily, because of the leaves which are flat and petiolate. The flowers appear as trysoid synflorescences, very dense. From a taxonomic point of view, plants from *Chenopodium* Genus (fam. *Chenopodiaceae*) are the most difficult to be described. In the paper published by [26], were investigated 67 of species belonging to *Chenopodium* genus and other 29 exemplars from segregated genera (*Einadia*, *Monolepis*, *Spinacia* and so on) and representatives of *Dysphanieae* family. The typology of fruits and seeds is similar for all members of the genus *Chenopodium* which were evaluated, except for some species (*C. strictum*, *C. vulvaria*), where the pericarp present dark compounds and not uncoloured as in the case of the other species [26].

From the Red List of superior plants in Romania, *Chenopodium wolffii* Simonkai is the only taxon considered endemic and disappeared [21]. In the study carried by [14], in Andean region, two species from *Chenopodium* spp, were selected: Quinoa

(*Chenopodium quinoa* Willd.) and kaniwa (*Chenopodium pallidicaule* Aellen) are native food plants with high nutritional constituents, being an important source of protein for the inhabitants of the region [14].

Table 1. The inventory of plants from *Chenopodium* botanical collection (extract)

Draw number	Plate/ voucher number	Herbarium / Botanical Collection / Institution	Species name	Collecting date	Collecting place	Collected/ Determined by:	Conservation degree (1...4)
95	16	Herbarium of the Bucharest Polytechnic School of Botany Laboratory	<i>Chenopodium album</i> L. ssp album	1918	Călugărească Valley	M. Haret	2
95	52	ICEF Institute of Forestry Research and Experimentation	<i>Chenopodium botrys</i> L.	1935	Breaza	Haralamb	1
95	100	Flora Romaniae exsiccatae / Museum Botanicum Universitatis Cluj	<i>Chenopodium urbicum</i> L.	1939	Ilfov forest district, Bucharest, 80 metres altitude	I. Morariu	1
95	67	Herbarium of Cluj University	<i>Chenopodium murale</i> L.	1914	Târgu Mureș	E.I. Nyarady	1
95	81	Herbarium of the Bucharest Polytechnic School of Botany Laboratory	<i>Chenopodium polyspermum</i> L.	1938	Maramureș, Vișeu de Jos	A. Coman	1
95	72	Herbarium Politehnica Bucharest Faculty of Forestry Laboratory of Botany	<i>Chenopodium opulifolium</i> Schrad	1947	București, Cișmigiu	I. Morariu	1
95	64	Herbarium of the Bucharest Polytechnic School of Botany Laboratory	<i>Chenopodium hybridum</i> L.	1935	Chișinău nursery	C.C. Georgescu	1

### Taxonomic characteristics and contributions in society of the most common species belonging to the *Chenopodium* Genus

(1) *Chenopodium album* L. or white goosefoot are annual herbs, with 15-150 cm in tall. The stem is erect, green or purple-red striate, ribbed, stout. Leaf is blade rhombic-ovate until broadly lanceolate. The glomerules are arranged into small or large panicles. The flowers are bisexual. Pericarp clasped to seed. The seeds are black, horizontal arranged, sublustrous and lenticular [31]. *C. album* is recognized for its multiple uses in food or medicine [30]. She grows in wasted places, being used as weed in crops where the umidity is present [4]. As traditional uses, *C. album* brings many benefits in restoring appetite, acting as a diuretic, laxative, tonic and anthelmintic. It is also used for the treatment of the abdominal pain or eye diseases. In phytochemistry, after [17], it was discovered that these plants contains an huge amount of primary metabolites (pentoses, methylpentoses, amino-acids, nonpolar constituents) and secondary metabolites (phenols, sterols, terpens, amids, vitamins and organic acids).



Fig.1. *Chenopodium album*

(2) *Chenopodium botrys* L. or *Dysphania botrys*, called the Jerusalem oak goosefoot (feathered geranium), is included in genus *Dysphania* (the glandular goosefoots). The area of provenance is the Mediterranean region. Related to the taxonomy, the plant has a strong scent, reminiscent of stock cubes. It is an annual plant, being intense cultivated [33]. The plants is utilized with success in catarrh and humoral asthma in Southern Europe and France, being a good substitute for *C. ambrosioides*. After [30], aerial part contains essential oils, having antibacterial and antifungicidal effects against microorganisms' strains. In Serbian traditional medicine, from the dried parts of

*C. botrys* infusions or liquid extracts were prepared that were used as remedies with diuretic, antispasmodic, carminative and antidiarrhoric properties. The herbs are usually used as spices [17].



Fig.2. *Chenopodium botrys*

(3) *Chenopodium opulifolium* L or grey goosefoot, is an erect annual or short-lived perennial herb, the branches spreading, often woody below, 60-150 centimeters in tall. It is spreaded in Central and Southern Europe, northern and eastern Africa, Arabian Peninsula to western and central Asia [24]. As edible uses the leaves can be consumed raw or cooked as a spinach [15]. The leaves are cooked in a mixture with other vegetables such as cowpeas, rice or potatoes. The seeds can be also cooked. They can be mixed with cereals, for making bread for example. As medicinal uses, the leaves are utilized in making steam baths, to treat colds and fever [24].

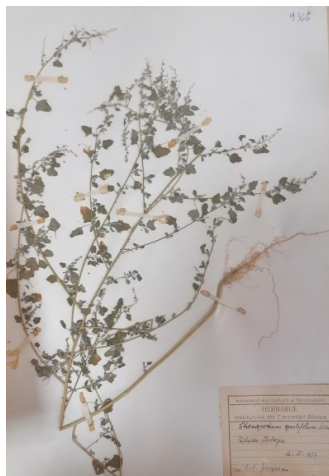


Fig.3. *Chenopodium opulifolium*



Fig.4. *Chenopodium polyspermum*

(4) *Chenopodium polyspermum* L, commonly known as many-seed goosefoot, is a summer-annual plant. She is reaching 10 up to 80 cm in tall, being glabrous or very slightly farinose on young segments. Stem is angular, green to red, hard, erect or sometimes procumbent, sparsely branched, with lower and long branches. Leaves are usually tinged with brown or red, with blades thin, glabrous or sparsely farinose. The margin is entire. Lower leaves longly petiolate with blade broadly ovate to ovate. The blade from middle leaves is narrower, pronounced elliptic and more obtuse. Bracts are elliptic, obovate or lanceolate [16]. Many-seeded goosefoot is native to Europe and northern Asia, being introduced to many parts of the world, including northeastern North America [32]. Regarding on the composition, the plants contain oxalic acid, which can lock up the nutrients in the food in large quantities. They are very nutritious vegetables in reasonable quantities. Cooking the plants will reduce their content of oxalic acid. People with signs of rheumatism, arthritis, gout, kidney stones or hyperacidity should take especial caution if including this plant in their diet [5].

**Collecting period.** The plants were harvested for a long period of time, most of the plants during the years 1930-1949 (64 vouchers), but also during the years 1870-1889 (14 vouchers), 1910-1929 (16 vouchers). After 1989, there was a decline in the number of harvested plants (figure 5). The herbarium is represented by the well-preserved species (figure 6), being registered a high number of plates with degree of conservation 1 (96 vouchers) and 2 (14 vouchers).

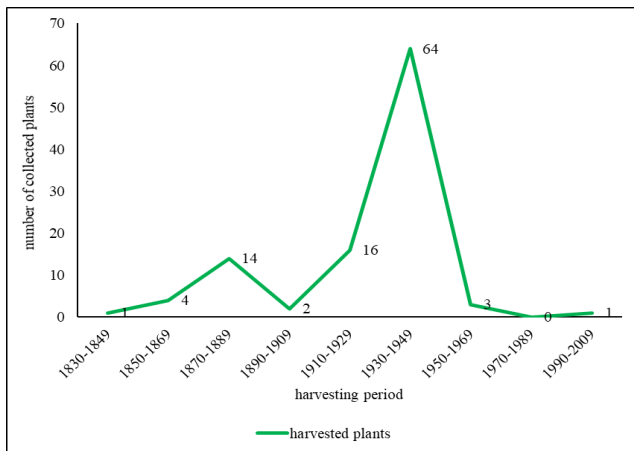


Figure 5. The time interval of collected plants

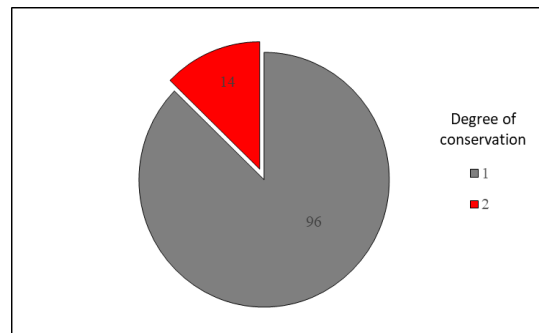


Figure 6. The degree of conservation for the analyzed plants

**Collecting place.** Most plants were collected from Romania, in the following counties (figure 7): Cluj- Turda (15 vouchere), Cluj-Napoca forest district, Cojocna forest district (14 vouchere); Prahova-Calugarească Valley (7 vouchere); Harghita-Miercurea Ciuc, Praid, Odorheiu Secuiesc, Tusnad

forest districts; Ilfov- Fundeni Lake, Cereanca forest (10 vouchere); Mures (Lapușna); Sibiu- Bradeni (3 vouchere); Buzau- Broasca forest (2 vouchere), Pogoanele (3 vouchere); Maramures- Viseul de Jos, Zavoii Mare; Caras-Severin; Arad-Șiria; Brașov-Poiana Tapului, Bran Gate; Timiș.

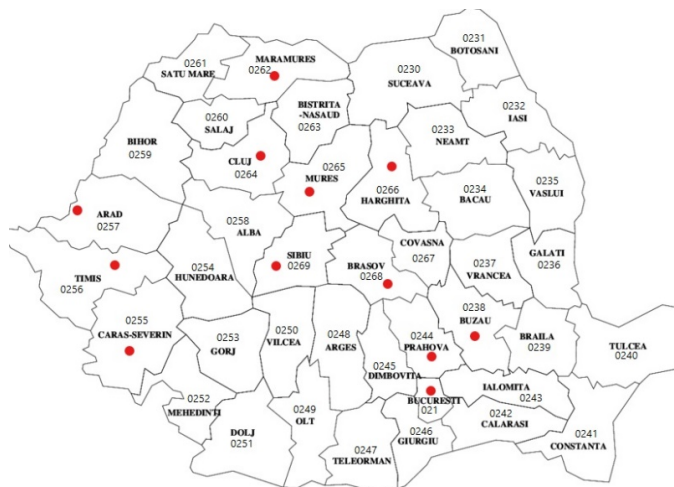


Figure 7. Places of collecting on Romanian map

The collection of plants was made by famous botanists, among whom we mention: *Woeff* (16 vouchers), *M. Haret* (7 vouchers), *E.I. Nyarady* (9 vouchers), *C.C Georgescu* (13 vouchers), *Al. Beldie* (3 vouchers), *At. Haralamb* (4 vouchers), *I. Prodan* (9 vouchers), *A.Coman* (6 vouchers), *I. Morariu* (14 vouchers), *S.Paşcovschi* (2 vouchers)

### Conclusions

From the collection of plants included in "Al.Beldie" herbarium, through the inventory process, 109 plates containing species of the *Chenopodium* genus were identified. A number of 46 taxa were

recorded, integrating here also the varieties of the species. Among of the plants belonging to this genus, *Chenopodium album L* (ssp) is representative, summing a number of 29 plates from which 13 plates with *C. album L*, covering a total number of 15 taxa (32% from the total number of taxa). Among the species of this genus, the most common are: *C.album L*, *C. botrys L* (syn. *Dysphania botrys*), *C. opulifolium L* and *C.polyspermum L*. The 4 taxa bring numerous uses in society, being utilised successfully in food and medical purposes. Most plants were harvested between 1930 and 1949 (64 vouchers were collected), by many famous botanists such as: *Woeff*, *M. Haret*, *C.C Georgescu*, *E.I Nyarady*, *I. Morariu* and many others.

The plants were harvested from over 10 counties of Romania, most of them coming from Cluj, Prahova and Ilfov counties. The storage of the plants was done carefully, this being confirmed by the presence of conservation degrees 1 and 2, can be used to reconstitute biological invasions as well as to assess the decline of species, starting with 1989. This kind of study, bring essential information for the general public, both for amateurs and for laborious research implemented by biologists, chemists, pharmacists and so on. The source of information contained in the updated databases is valuable especially among the community of botanists and ecologists who use herbaceous extracts to evaluate spatio-temporal indicators that show the evolution of the dynamics of phytogeographic, geological and geomorphological phenomena.

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