RESEARCH ON THE BOTANICAL AND PHARMACOGNOSTIC PARTICULARITIES OF THE INDIGENOUS SPECIES *LYSIMACHIA NUMMULARIA* L.

Suciu Felicia[1]
Arcuș Mariana[2]
Roșca Adrian Cosmin[3]
Bucur Laura[4]
Popescu Antoanela[5]
Badea Victoria[6]
[1, 2, 3, 4, 5] Faculty of Pharmacy, Ovidius University of Constanta, Romania
[6] Faculty of Dentistry, Ovidius University of Constanta, Romania

ABSTRACT

Preliminary pharmacochemical research on *Lysimachia nummularia* L. was performed by dint of pharmacognostic analysis (macroscopic examination, global chemical analysis, preliminary quantitative determinations).The article includes the analysis of the macroscopic characters of the vegetative organs (root, stem and leaf), as well as of the reproductive organs (flower, fruit, seed) belonging to the spontaneous native species *Lysimachia nummularia* L.

Morphological features were described and discussed. The identification of these aspects was done with the naked eye, but also with the help of a hand magnifier and a binocular magnifier. The results revealed that the external appearance of the plant justifies the species belonging to the genus *Lysimachia*, family *Primulaceae*. They are found in the glabrous and creeping appearance of the plant, opposite, almost round leaves, solitary, yellow flowers, axillary with vigorous pedicels, perianth pentamer, actinomorphic, dialisepal and dialipetal, globular capsule fruit. The semi-hydrophilic nature is found in the presence of adventitious roots that develop both from the rhizome and at the nodes of the stem. The preliminary quantitative determinations performed were loss by drying as well as soluble substances of the species *Lysimachia nummularia* L. Following the global chemical analysis, active principles known in the literature for the antioxidant potential were identified. Following the preliminary quantitative determinations (drying loss, determination of soluble substances) results comparable to those in the literature on the content of volatile substances and soluble substances were obtained.

Keywords: *Lysimachia, macroscopic, pharmacognostic analysis, active principle*

INTRODUCTION

The paper aims at a broader study both botanical - morphological and histoanatomical, but especially pharmacognostic and phytochemical of the species *Lysimachia nummularia* L. (Fam. *Primulaceae*). The idea of this study started from

the fact that in the literature, the plant has proven, following scientific research, to be beneficial in various diseases, due to the presence of some active principles with phytotherapeutic potential in the structure of its tissues.

Thus, in traditional medicine, it is used internally to treat ulcers, diarrhea, dysentery and tuberculosis, and externally to heal wounds and skin ulcers [1].

In cultured medicine, studies have shown the presence of polyphenolic compounds, flavonoids, anthocyanosides, tannins [2], [3], [4], [5], [7], [8], due to which the plant would have a significant antioxidant potential, as well as a triterpene saponoside - nummulariozide [9], [10], isolated from the underground parts, showing cytotoxic (antitumor) activity important in five human cancer cell lines [6], [12], [13], [14], to which are added the antibacterial, antirheumatic and analgesic effects.

In this article we tried a preliminary study aimed at knowing the macroscopic characteristics of both vegetative (root, stem, leaf) and reproductive (flower, fruit, seed) organs belonging to the native spontaneous species *Lysimachia nummularia* L and preliminary pharmacognostic determinations (chemical analysis qualitative, preliminary quantitative analysis).

MATERIALS AND METHODS

The working material was represented by the plant *Lysimachia nummularia* L., harvested on July 19, 2020, on the edge of Lake Tău-Brazi in the Roșia Montană area (Fig. 1). Here, the plant in full anthesis, develops on considerable surfaces, forming well-defined associations and dominates the area due to its plagiotropic feature (Fig. 2). The collected specimens were herbivored and determined in the Pharmaceutical Botany Laboratory within the Faculty of Pharmacy, using for this purpose the flora determinants from the laboratory equipment [15]. Several herbaceous specimens are in the custody of the Pharmaceutical Botany Laboratory.

For the preliminary pharmacognostic determinations, the pharmacognostic analysis was used as a working tool (macroscopic examination, qualitative chemical analysis, determination of drying loss, determination of soluble substances).

To establish the macroscopic characters, the species was analyzed with a hand magnifier and a binocular magnifier.

The pharmacognostic analysis consists of two groups of methods: quantitative methods and qualitative methods.

Qualitative methods lead to the determination of the identity of a plant product and include the Examination, macroscopic, microscopic and chemical (microchemical and qualitative chemical).

Quantitative methods aim to determine the purity and quality of a plant product.

For the pharmacognostic analysis were used the vegetal products obtained from the species *Lysimachia nummularia* L.: *Lysimachiae* radix, *Lysimachiae* herba and *Lysimachiae* flores.

The vegetable products were obtained from the species *Lysimachia nummularia* L. after drying and sorting.

The qualitative chemical analysis is based on the successive extraction of the plant product used, with solvents of different polarities and the identification by reactions characteristic of each group of active principles. The reagents used in identifying the active principles are reagents for analysis from various domestic and imported companies.

Determination of drying loss is a preliminary quantitative pharmacognostic method that represents the degree of humidity of plant products, which must be within certain limits, so as to ensure the preservation of plant products.

The working method involves the following technique.

The weighing vials with the vegetable products previously brought to a constant mass, together with the sample taken, are kept in the oven at 105^0C for 3-4 hours, unless otherwise provided, cooled in a desiccator and weighed. Continue drying for 1 hour, followed by cooling in the desiccator and weighing until the samples reach a constant mass. A KERN ABJ analytical balance was used to weigh the samples.

Determination of soluble substances is the amount of substances that are soluble in a given solvent, per 100 grams of dried vegetable product. This preliminary quantitative determination has indicative value as regards the amount of active principles soluble in a given solvent.

Taking into account the solubility of the active principles known in the literature, as well as the extraction possibilities, we used in this determination three solvents, namely: ethanol 40% (v / v), ethanol 96% (v / v) and water. Thus, the determination of soluble substances was performed for each plant product (*Lysimachiae* radix, *Lysimachiae* herba and *Lysimachiae* flores) in the three solvents mentioned above.

The following working technique was used to determine the soluble substances:

2.5 g of vegetable product, sprayed according to the provisions of the respective monograph, are weighed on the analytical balance and brought into a vial with a ground-in stopper; add 100 g of the solvent provided, shake vigorously several times, leave to soak for 23 hours, shake again for 1 hour and filter, removing the first portions of the filtrate. 10 g of the filtrate are evaporated to dryness on a water bath in a pre-calibrated weighing ampoule. The weighing vial with residue is dried in the oven; at 105^0 C, for 3-4 hours, cool in the desiccator and weigh.

RESULTS AND DISCUSSIONS

Lysimachia nummularia L., is a herbaceous, perennial plant (Figure 1, Figure 2), spread through meadows and bushes, in forests, streams, wet depressions, through water holes, meadows and on the waterfront, in the plains and hilly regions from all over the country.

Fig.1. *Association with Lysimachia nummularia L.*

Fig. 2. *General appearance of the species Lysimachia nummularia L.*

From a macroscopic point of view, underground, it presents a rhizome with nodes and internodes, with thin adventitious roots starting from the nodes (Figure 3). The stem is sudden, 10-50 cm long, glabrous, simple or weakly branched, in four edges, at nodes with bundles of adventitious roots (Figure 4).

Fig. 3. *Lysimachia nummularia L. – roots with nodes and internodes*

Fig. 4*. Lysimachia nummularia L.- simple glabrous stems*

The leaves are opposite, round or elliptical, obtuse, with entire edges, very shortly petiolated, with red glandular points (Figure 5).

The solitary hermaphroditic flowers, arranged in the axils of the leaves (Figure 5), have floral pedicels the length of the leaves, sometimes even longer. The floral coating is a perianth made of calyx and corolla.

Fig. 5. *Lysimachia nummularia L. - Opposite round elliptical leave*

Fig. 6. *Lysimachia nummularia L. Solitary flowers in the leaf axils*

The actinomorphic calyx consists of five free sepals, 7 mm long, with cordiform lacinas, separated to the base (dialisepal) (Figure 6, 7).

Fig. 7. *Lysimachia nummularia L. - calyx with cordiform lacinae*

Fig. 8. *Lysimachia nummularia L. - calyx with cordiform lacinas - dialisepal pentamerous corolla*

The corolla is intensely yellow, with a glandular reddish dotted interior, about 15 mm wide, twice as wide as the calyx, divided almost to the base into obovate, obtuse lacrines with full edges. It is pentamerous, actinomorphic, dialisepal (Figure 8).

The androecium consists of five stamens (Figure 9), two to three times shorter than the corolla, with hairy glandular filaments at the base. Stamen length style. The fruit is a capsule only rarely developed, globular, 4-5mm long, shorter than the calyx, whitish yellow, with small red secretory sacs. Blackish seeds, in 3 edges, warty, 1-1.5 mm long.

Fig. 9. *Lysimachia nummularia L. - Androecium of 5 stamens*

Following the general chemical analysis performed, the following types of active principles were identified as follows:

In the roots of *Lysimachia nummularia* L. were identified: volatile oil, sterols (triterpenes), flavonic aglycones, carotenoids, coumarins, tannins (gallic tannins, catechin tannins), flavonosides, coumarins heterozidates, heterozides o, triterpenes, (ortho dihydroxy phenols) ODP, poliosis, polyuronides, saponosides.

The following classes of active principles have been identified in the plant product *Lysimachiae* herba: volatile oil, sterols (triterpenes), flavonic aglycones, carotenoids, fatty acids, coumarins, tannins (Galician tannins, catechin tannins), flavonoids, heterosidium coumarins, heterosides, ODP, reducing compounds, oases, polyoses, polyuronides, saponosides.

Following qualitative chemical analysis, the flowers of *Lysimachia nummularia* L. contain: volatile oil, sterols (triterpenes), flavonic aglycones, carotenoids, fatty acids, coumarins, tannins (gallic tannins, catechin tannins), flavonoids, heteropidate coumarins, ODP, reducing compounds, oases, polyoses, polyuronides.

Comparing the results obtained by us with those mentioned in the literature we found the following:

- the presence of flavonosides is also mentioned in the literature in all parts of the plant *Lysimachia nummularia* L. Thus, throughout the plant were identified rifolin, isoquercitrin, myricitrin, mearnsitrin, syringetin 3-galactoside, kaempferol 3-O-rhamnosyl (1 → 2) galactus, quercetin 3-O-neohesperidioside, rutin, kaempferol 3-O-(2,6-dirhamnosylgalactoside) and quercetin 3-O- (2,6-dirhamnosylgalactoside) [5];
- species of the genus *Lysimachia* contain kaempferol, quercetin and myricetin in: L. vulgaris, L. *nummularia,* L. *punctata*, L. *christinae*, L. *ciliata* and L. *clethroides*, respectively, which demonstrates the presence of flavonic aglycones identified by us [7];

- polyphenolic compounds were also determined in species of the genus Lysimachia sp, *Lysimachia nummularia* L., *Lysimachia vulgaris* L. and *Lysimachia punctata* L [6].
- Thus, the identification of the constituents from the groups of active principles highlighted in the researched plant product will be possible also through the correlation between metabolism and phylogeny.

The loss results for the plant products *Lysimachiae* radix, *Lysimachia*e herba and *Lysimachiae* flores are summarized in the table below:

Table 1. *Results of preliminary determinations*

N°	**Vegetable product**	**Loss on drying Quantity (g% ± SD)**
1.	*Lysimachiae radix*	8,6043 ±0,5125
2.	*Lysimachiae herba*	8,54086±0,1070
3.	*Lysimachiae flores*	7,4941±0,5408

The values of the loss by drying show that the vegetal product taken in work falls within the limits allowed by FR X and Ph. E. 10.0 (3 - 13%) in terms of the content of volatile substances at 100°C, to ensure their good shelf life. Regarding the content of soluble substances in different solvents, it is observed that most substances are soluble in 40% ethanol.

Table 2. *Results of preliminary determinations - soluble substances*

Crt. no.	**Vegetable product**	**Determination of soluble substances in different solvents**	**Soluble substances (g% ± SD) Dried vegetable product**
1.	*Lysimachiae radix*	Ethanol soluble substances 40%	54,1038±0,4055
		Ethanol soluble substances 96 %	23,5023±0,7913
		Water soluble substances	41,3076±0,6882
2.	*Lysimachiae herba*	Ethanol soluble substances 40%	62,9067±1,1140
		Ethanol soluble substances 96 %	27,6922±0,4269
		Water soluble substances	54,5582±0,3369
3.	*Lysimachiae flores*	Ethanol soluble substances 40%	81,4685±1,3784
		Ethanol soluble substances 96 %	53,6120±0,9132
		Water soluble substances	66,6908±1,2166

CONCLUSION

The analysis of the macroscopic characters of the studied species confirms that the plant is *Lysimachia nummularia* L. from the *Primulaceae* family, because these characteristics are in accordance with the description of the species in the literature, respectively in the flora determinants in Romania. Among these characters are the plagiotropic feature, the glabrous appearance of the vegetative organs, the opposite position of the almost round leaves, the solitary, axillary yellow flowers.

The presence of several groups of active principles in all organs of the species *Lysimachia nummularia* L. leads us to the conclusion that the species is of interest and can be researched for therapeutic recovery purposes.

The product does not contain cardiotonic alkaloids and heterosides (toxic compounds) or anthracenosides (laxative compounds). The values of drying loss show that the vegetable products used correspond to their preservability.

As the largest amount of substances are soluble in 40% ethanol, it determines us in the following research to take extracts obtained in 40% ethanol.

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