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ECOPHYSIOLOGICAL CHARACTERISTICS IN SPECIES WITH MEDICINAL VALUE FROM REDIU FOREST (BOTOŞANI COUNTY)

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Abstract: This paper presents the results of the determinations of physiological parameters (content of water, dry substance, total mineral elements, assimilatory pigments, concentration of cellular juice) at herbaceous or woody species that have medicinal value. The species that were analyzed are characterised by a high content of water, assimilatory pigments and a good capacity to exploit the mineral elements from the soil, capacity that is rendered by an appreciable amount of total mineral elements. The concentration of the cellular juice in leaves and flowers presents low-moderate values except for the species *Origanum vulgare, Melilotus officinalis* and *Galium verum* for which high values have been recorded.

Keywords: species with value medicinal, physiological indicators.

Introduction

Physiologic/Ecophysiologic studies on herbaceous species from the forest ecosystems have been realized by Romanian and foreign authors. The studies performed were focused on the following aspects: water regime (water content, concentration of cellular juice, osmotic pressure) [20; 24; 16; 17; 18]; pH of the cellular juice [20; 24; 25], content of dry substance, content of ash/mineral elements [16-18; 22]; assimilatory pigments [19; 20; 8; 11; 15-18].

The paper aims at emphasizing some ecophysiological characteristics in the species with medicinal value in the pedo-climatic conditions specific to Rediu forest.

The studied species contain active compounds (flavonoids, polyphenols, essential oils, bitter principles, anthocyanins, carotenes, vitamins, polyphenol carboxylic acids, tannins, etc.) that confer to them different pharmaceutical properties (antioxidant, anti-inflammatory, antimicrobial, antiseptic, stomachic, diuretic, etc.) [6; 9; 21] and for this reason they have been studied especially from the phytochemical and pharmaceutical point of view [1; 3; 9; 14; 26].

For some species from the study (*Crataegus monogyna, Pulmonaria officinalis, Galium odoratum, Galium verum, Geranium robertianum*, *Hypericum perforatum*, *Sambucus nigra, Prunela vulgaris*) have also been performed physiological / eco-physiological researches [8; 11; 19; 20; 22; 24; 25; 16; 18; 13].

Materials and methods

Rediu forest is located in the south-eastern part of Botoşani city at a distance of 3 km. The forest has an area of 130,6 hectares and is divided in 5 parcels (97-101) from the forest point of view. It makes part of the Poieniţa Production Unit IV [29]. The

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altitude of forests in Poienița Production Unit IV varies from 78m to 227m. It is a hill forest dominated by common oak and pedunculate oak. The climate of forest is part of the climate land of the Moldavian Plateau. The soils in Rediu forest are part of the class of clay soils, brown luvic type. According to the degree of saturation of the exchange base, the soils are mesobasic with sufficient resources of mineral substances and water deficiency during summer [29].

Among the species that form the arborescent layer we can mention *Quercus petraea*, *Q. robur, Tilia tomentosa, T. cordata, Fraxinus excelsior, Acer campestre, A. tataricum, A. pseudoplatanus, A. platanoides, Carpinus betulus.* The arborescent layer is made of *Crataegus monogyna, Cornus sanguinea, C. mas, Evonymus verrucosus, E. europaeus, Viburnum opulus, Sambucus nigra* etc. Among the species that made the herbaceous layer we can mention *Pulmonaria officinalis, Ranunculus ficaria, Anemone ranunculoides, Galium odoratum, G. aparine, Filipendula hexapetala, Alliaria petiolata, Asarum europaeum, Campanula trachelium, Geranium robertianum Scrophularia nodosa, Glechoma hederacea, Veronica chamaedrys, Staphyllea pinnata* etc.

Ten species belonging to eight botanic families were taken into account (Tab. I). The biological material (represented by flowers/inflorescences and leaves) was sampled from exemplars in the blooming phenophase, during the vernal - aestival period (March – July) of 2008. Referring to the ecological requirements, most of the species to be studied are mesophytes / mesotrophic/eutrophic and heliophilous (heliosciophytes*)* (Tab. I).

Table I. The ecological characteristics (Doniță et al., 1977; Sanda V. and Popescu A., 1983; Pârvu C., 2006)

Species	Family	The preferences for trophicity	The preferences for soil humidity	The preferences to lihgt
Pulmonaria officinalis L.	Boraginaceae	eutrophic	mesophylous - meso-higrophylous	helio-sciophylous
Crataegus monogyna L.	Rosaceae	mesotrophic	mesoxerophylous mesophylous	heliophylous, helio-sciophylous
Sambucus nigra L.	Caprifoliaceae	eutrophic	mesophylous	heliophylous, helio-sciophylous
Melilotus officinalis L.	Fabaceae	mesotrophic-eutrophic	mesoxerophylous -mesophylous	heliophylous
Hypericum perforatum L.	Hypericaceae	oligotrophic	mesophylous	heliophylous
Geranium robertianum L.	Geraniaceae	eutrophic	mesophylous - meso-higrophylous	helio-sciophylous; sciophylous
Prunela vulgaris L.	Lamiaceae	mesotrophic - eutrophic	mesophylous	helio- sciophylous
Galium odoratum (L.) Scop.	Rubiaceae	mesotrophic	mesophylous	sciophylous
Origanum vulgare L.	Lamiaceae	oligotrophic-mesotrophic	mesoxero phylous - mesophylous	heliophylous; helio-sciophylous
Galium verum L.	Rubiaceae	oligotrophic	mesoxero phylous - mesophylous	heliophylous

The following physiological indicators have been determined: content of water and dry substance (gravimetrical method) [2], concentration of cellular juice (refractometrical method), content of total mineral elements (dry calcination at 450^0 C method) [2], content of chlorophyll pigments and absorption spectra of assimilatory pigments (spectro-photometrical method).

For the determination of the absorption spectra of assimilatory pigments was used and extract of pigments in 85% acetone. A UV-VIS spectrophotometer was used and the extinction values have been read from 20 to 20 nm in the 400-700nm range.

Results and discussions

The water content registers values between 67.97 g % and 85 % in leaves, and between 70.41 g % and 85.66g % in flowers. In the leaves the highest values of water content have been recorded at the species *Geranium robertianum* (85 g %), *Pulmonaria officinalis* (84.4 g %) and *Prunela vulgaris* (81.73 g %) (Fig. 1). The highest values of water content in flowers have been recorded at the species *Pulmonaria officinalis* (85.66 g %) decreasingly followed by the species *Sambucus nigra* (83.92 g %) and *Crataegus monogyna* (83.55 g %) (Fig. 2). The species *Origanum vulgare* and *Galium verum* – heliophiles and xeromesophytes – mesophytes presented a low hydration degree in leaves as well as in flowers.

The dry matter contains mineral elements and the organic substances from the analysed organs and reflects the biomass accumulation. In our case, the dry matter content registers values between 15 g % and 32.03 g % in leaves, and between 11.27 g % and 29.59 g % in flowers (Figs. 1, 2).

The concentration of the cellular juice in leaves varies from low - moderate values (5.4 - 11.1 % saccharose) (registered at *Geranium robertianum, Pulmonaria officinalis, Hypericum perforatum* and *Galium odoratum*) to high values (21.3 % - 23.1% saccharose) (registered at *Melilotus officinalis* and *Origanum vulgare* - xeromesophyte – mesophyte species) (Fig. 3).

The concentration of the cellular juice in flowers registered decreased – moderate values (6.7 - 15.4 % saccharose); except for the *Galium verum* species where the concentration of the cellular juice registered high values (Fig. 3).

It is observed in most analyzed cases that there was a negative correlation between water content and the concentration of cellular juice (in leaves and in flowers): the species which have a higher water content indicate a lower concentration of the cellular juice and those with a lower water content indicate a higher concentration of the cellular juice.

The content of total mineral elements registers values between 4.61 g % and 11.57 g % in leaves, and between 4.38 g % and 9.39 g % in flowers (Fig. 4). With the exception of *Crataegus monogyna* species, the content of total mineral elements in all the analysed species registered higher values in leaves than in flowers. *Geranium robertianum, Prunela vulgaris* and *Galium verum* species distinguish themselves through high values of the contents of total mineral elements. The lowest value of the content of total mineral elements was registered in *Hypericum perforatum* (4.61 g % - leaves; 4.38 g % - flowers) – oligotrophic species.

The content of chlorophyll pigments registered a varied range of values comprised between 0.5333 - 2.3525 mg pigments ⁄g fresh material for chlorophyll a and between 0.1567 – 1.6422 mg pigments⁄g fresh material – for chlorophyll b (Fig. 5).

One can notice the fact that *Pulmonaria officinalis* (vernal heliosciophyte species) presents the lowest content of chlorophyll pigments (chlorophyll a and b). This fact complies with the specialty literature [19] that shows that vernal plants have less chlorophyll than the estival ones.

The proportion chlorophyll a/b has values comprised between 1.09 – 3.40, fact which indicates an own rhythm of biosynthesis of the two types of chlorophylls at each species (Fig. 5). At *Pulmonaria officinalis* and *Crataegus monogyna* species, the contents of chlorophyll a is 3.4 times, respectively 2.94 higher than that of chlorophyll b.

The assimilatory pigments have the capacity of selectively absorbing the radiations of the solar spectrum according to their properties of structure.

The results that we have obtained for the 4 investigated species highlight higher values of the extinction in the field of blue radiations as these radiations have the highest quantity of energy and are better absorbed by the yellow pigments (Fig. 6). According to Inada (1976) cited by Burzo et al. (1999) [4], the quantum of the red radiations have a lower weight and are better absorbed by chlorophyll molecules from several species of plants, achieving a second maxim of the intensity of the process of photosynthesis.

The determinations referring to the absorption spectra of assimilatory pigments performed by us with acetonic extracts of assimilatory pigments from the test species confirm the data in the specialty literature [4; 10].

In the case of the investigated species there is noticed a correlation between the contents of the assimilatory pigments and their ecological requirements for the light regime.

The highest values of the extinctions (absorbance) for all the investigated bands are noticed in the case of the estival species; among these there are differences depending on the ecological requirements towards the light regime. In the first place there is *Hypericum perforatum* species, followed by *Melilotus officinalis* and *Geranium robertianum* species. In the case of *Pulmonaria officinalis* there are noticed the lowest values of extinctions (Fig. 6).

Furthermore, in the heliofite estival species there are noticed the highest values of extinctions in the field of blue radiations. This fact shows a good absorption and highlights the role of carotenoidic pigments both in the absorption of radiations photosintetically active and in the protection of chlorophyll pigments against photo-oxidation.

The physiologic features have a variability between certain limits determined by the genetic characteristics of the species, by the morpho-anatomic particularities of the foliar limb and by the micro-climatic conditions in the resorts these species vegetate. Therefore, in the conditions of some forest ecosystem in Transilvania, Tăcină Aurica and Păucă - Comănescu Mihaela (1985) [24] determine to *Pulmonaria officinalis* a water content from the leaves with value of 89 %; for the proportion chl a/chl b there were obtained value of 3.06. In our case, at *Pulmonaria officinalis,* the *water content* was of 84.4 % and the proportion chl a:chl b had the value of 3.40. Murariu et al. (2000) determine for *Pulmonaria officinalis, Galium odoratum* and *Geranium robertianum* gathered from the forest ecosystems in the hills of Tutova a water content with values greater than 80 g % [16]. In the assessments made by us, the water content in leaves at this species registered the values of 84.4 g % respectively 79.13 g % and 85 g %.

Reffering to the structure of the lamina, the specialty literature present the following data. The foliar limb is hipostomatic at *Crateagus monogyna, Hypericum* *perforatum* [27] and *Pulmonaria officinalis* [12] and amphistomatic at *Melilotus officinalis, Origanum vulgare* [27], *Prunela vulgaris* [3; 13], *Gallium verum* [13].

The mesophyll is differenciated in palisade tissue formed of one layers of cells at *Origanum vulgare* [27], *Pulmonaria officinalis* [12], one - two layers of cells at *Galium odoratum* [27], two layers of cells at *Melilotus officinalis* [27] or two - three layers of cells at *Hypericum perforatum*, *Crateagus monogyna* [27] and spongy tissue.

Conclusions

The obtained results reveal specific variations of the analyzed indicators for all the investigated species, the determined values presenting comparable ranges for each indicator apart.

Among the analyzed species, the species *Pulmonaria officinalis* remarks itself through the highest degree of hydration of tissues from leaves and flowers, decreased concentration of the cellular juice, low content of chlorophyll pigments.

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Explanation of the plates

Plate I:
Figure 1. The content of water and dry matter in leaves
Figure 2. The content of water and dry matter in flowers
Figure 3 The concentration of the cellular liquid

Plate II:
Figure 4. The content of total mineral elements
Figure 5. The content of chlorophyll pigments
Figure 6. The absortion spectra of assimilatory pigments

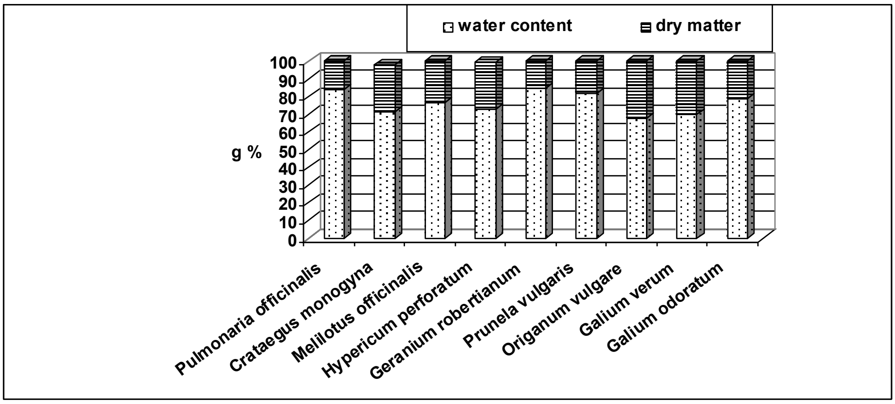

Figure 1

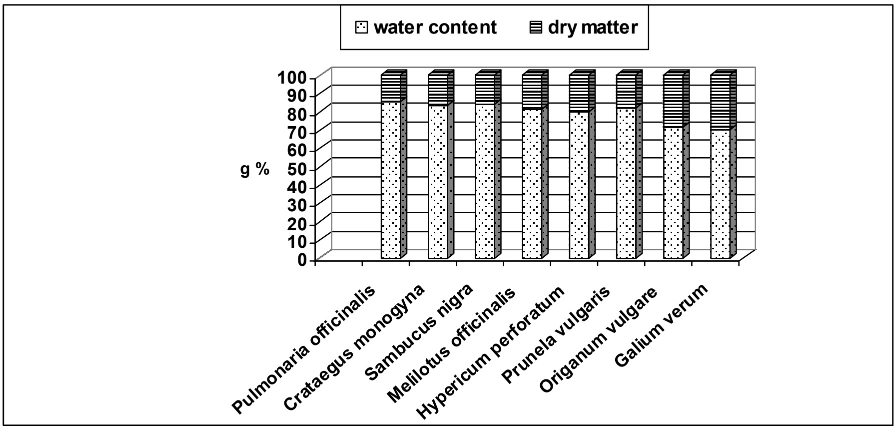

Figure 2

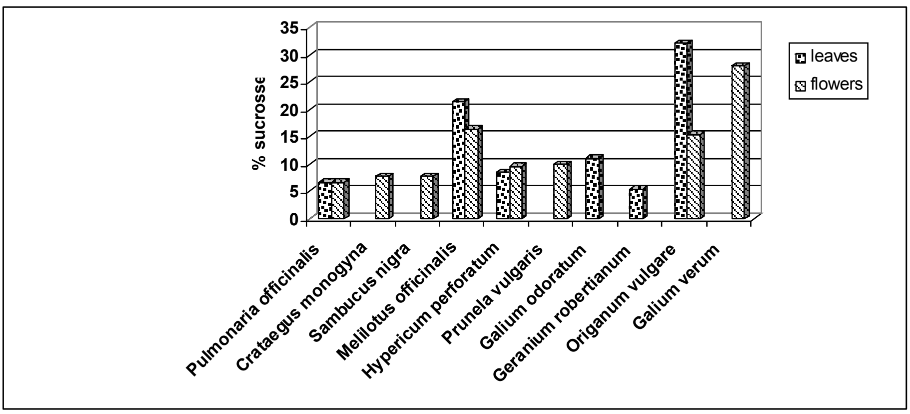

Figure 3

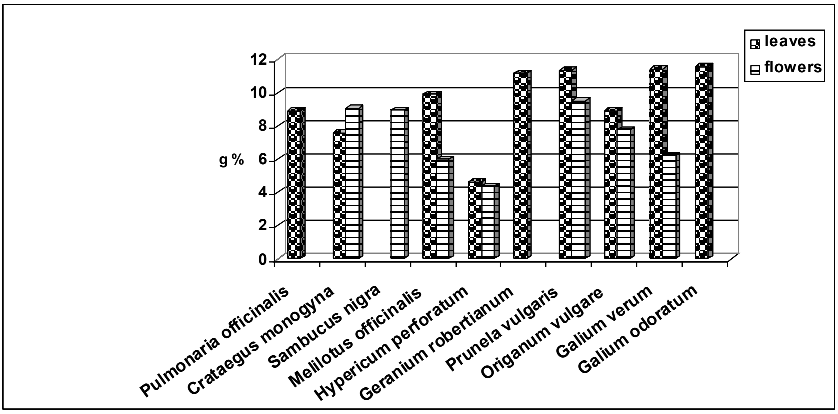

Figure 4

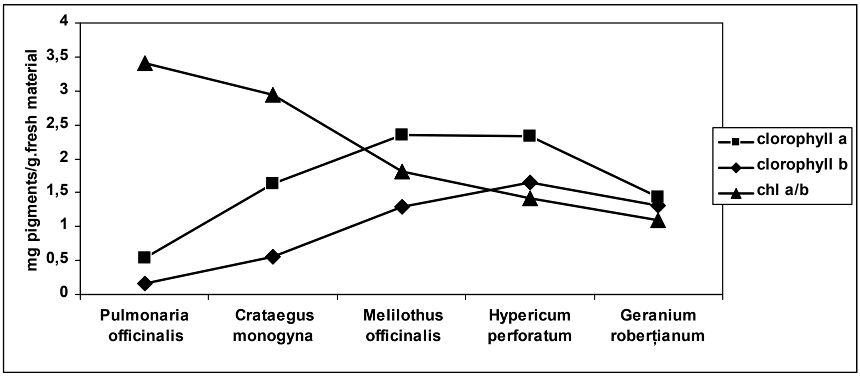

Figure 5

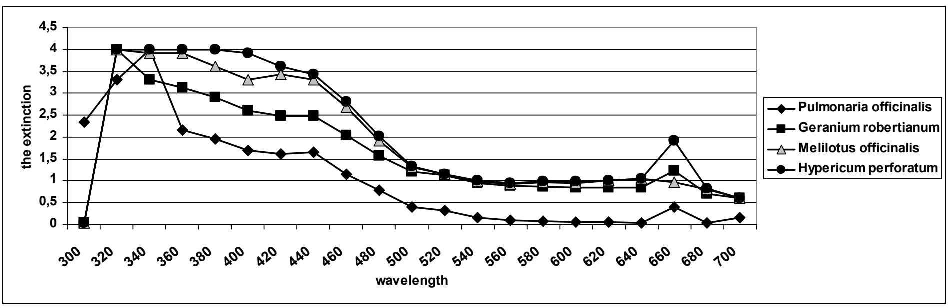

Figure 6