

***Dracocephalum moldavica*,
Nepeta cataria var. *citriodora* AND
Satureja montana – ESTIMATION OF
DRY HERB YIELD IN SERBIAN
AGRO-ECOLOGICAL CONDITIONS**

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SUMMARY

Dracocephalum moldavica L., *Nepeta cataria* L. var. *citriodora* (Becker), and *Satureja montana* L. (*Lamiaceae* family, *Nepetoideae* subfamily) are medicinal and aromatic plants, widely used in medicine, pharmaceutical, and food industries. This investigation aimed to estimate dry herb yield obtained from the harvested aerial plant parts of the selected species. The second aim was to study relationships among parameters related to fresh and dry plant weight. Fresh weight decreased after drying: 3.7-, 2.9- and 2.8-times for *D. moldavica*, *N. cataria* var. *citriodora* and *S. montana*, respectively. These results show that the drying index points to kg of fresh plant material required to obtain 1 kg of dry herb. Moisture content was 8.0-, 9.0- and 5.9-fold higher in fresh plant material compared to dry *D. moldavica*, *N. cataria* var. *citriodora* and *S. montana*, respectively; however variation for all tested parameters indicate uniform moisture content in plants which vary in weight. These observations could help growers to estimate dry herb yields of the investigated plant species immediately after harvest.

KEYWORDS: lemon catnip, moisture content, Moldavian balm, plant mass, winter savory

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INTRODUCTION

Lamiaceae are an important plant family that consists of more than 7000 species distributed all over the world (Li et al., 2016). This family is divided in seven subfamilies, with *Nepetoideae* Burnett. as the most numerous subfamily (Shanaida et al., 2018). The subfamily includes essential oil-rich plants, which include genera such as *Mentha*, *Lavandula*, *Salvia*, *Origanum*, *Thymus*, and others. These species were traditionally used for flavoring, food preservation, and medicinal purposes, due to their aromatic, curative, and preventive properties (Carović-Stanko et al., 2016).

The present study focused on three *Lamiaceae* species belonging to *Nepetoideae* Burnett. subfamily – *Dracocephalum moldavica* L., *Nepeta cataria* L. var. *citriodora* (Becker), and *Satureja montana* L., which are grown as raw material for herbal teas or processing for industrial applications. These plants have a good potential for growth in Serbia, however, only *S. montana* is cultivated in small areas, while the other two plants are cultivated as ornamentals. *D. moldavica*, also known as a Moldavian balm or Moldavian dragonhead, is an annual plant with citrus-like flavor, used as a composition of tea blends (because of its

fragrance), as a spice for food and beverage aromatization (canned fish, jams, candies, syrups), in perfumery, soaps and detergents preparations (Aćimović et al., 2019). *N. cataria* var. *citriodora* or lemon catnip is a perennial herbaceous plant with a lemony-mint flavor, used for tea preparation (as a sedative and soporific drug), as raw material for the food and beverage industry (dessert dishes, cheese, sausages, vegetable, and fruit canned food), as well as for industrial production of citral (Aćimović et al., 2021). *S. montana* or winter savory is a perennial semi-bushy herb with a characteristic *aroma* and fresh, spicy notes reminiscent of oregano and thyme, used as herbal tea (for respiratory diseases) and in the food industry (as a spice for seasoning of meat and fish, soup, sauces, canned food) in form of spice, essential oil or different types of extracts (Wesołowska et al., 2014; Moreira et al., 2020).

This investigation aimed to estimate fresh and dry herb yield obtained from aerial plant parts of *Lamiaceae* species *Dracocephalum moldavica*, *Nepeta cataria* var. *citriodora*, and *Satureja montana*. The second aim was to study relationships among parameters related to fresh and dry plant weight.

MATERIAL AND METHODS

Plant material used in this study was *Dracocephalum moldavica*, *Nepeta cataria* var.

citriodora, and *Satureja montana* cultivated in the experimental fields of the Institute of Field and Vegetable Crops Novi Sad, National Institute of the Republic of Serbia, located in Bački Petrovac. The main plots consisted of three rows, each 70 m long. Inter and intra-row spacing was 120x50 cm for *N. catara* var. *citriodora* and *D. moldavica*, and 70x30 cm for *S. montana*. The plants were collected during the flowering period (July 2021). The samples consisted of 30 plants divided into three replications. The aboveground parts were harvested manually, 5-10 cm above the soil surface, and dried in a solar dryer (30-35 °C) to a constant weight (approximately two days). Plant materials were weighed using a technical balance and expressed in g. Moisture content was determined by drying of plant samples 3 h at 105 °C (Ph. Jug. V, 2000). Moisture content was expressed as a percentage.

The following parameters were analyzed: fresh weight (the weight of plants immediately after the harvest, g), dry weight (after drying to constant weight, g), initial moisture content (immediately after the harvest, %) and final moisture content (after drying to constant weight, %).

Drying and moisture indices were calculated as the ratios of fresh and dry weight, and initial and final moisture content, respectively.

Basic statistic parameters (mean values and coefficients of variation) were calculated for the investigated parameters.

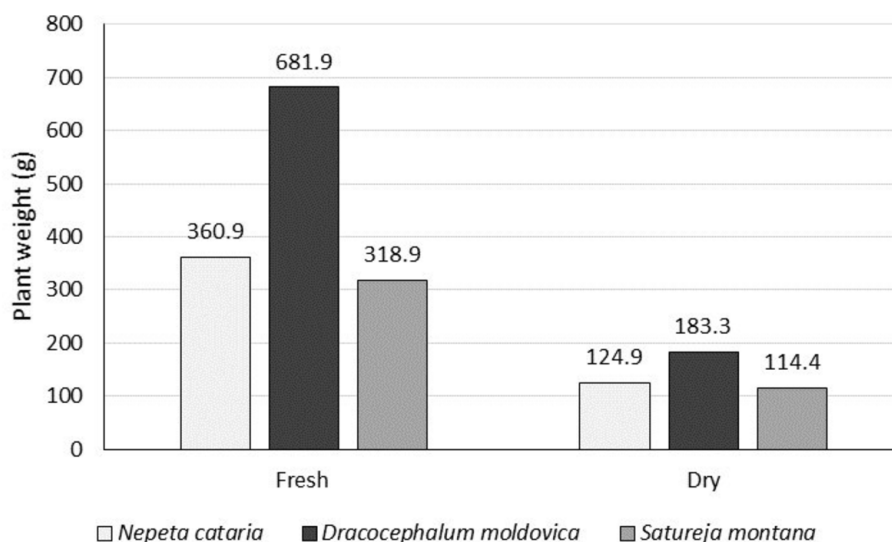


Figure 1. The fresh and dry weight of the plants from *Lamiaceae* family

RESULTS AND DISCUSSION

Fresh and dry plant weights of the investigated species are shown in Figure 1. The fresh plant weight was the highest for *D. moldavica* (681.9 g/plant), followed by *N. cataria* var. *citriodora* and *S. montana* (360.0 and 318.9 g/plant, respectively). The same trend is noted in the case of dry plant material: the highest weight had *D. moldavica* (183.3 g/plant), followed by *N. cataria* var. *citriodora* and *S. montana* (124.9 and 114.4 g/plant).

Investigation on *D. moldavica* grown in Egypt showed that herb fresh weight varies between 376.7 and 843.9 g/plant, and dry herb weight between 79.0 and 118.9 g/plant depending on the fertilization regime (Hussein et al., 2006). Another experiment, conducted in the same environment, with *N. cataria* var. *citriodora* showed that the fresh weight of plants was between 24.7 and 50.4 g in the first cut and 37.8 and 71.5 g in the second cut in the first growing season, while in the second growing season it varied between 26.8 g and 51.2 in the first cut and 40.8 and 67.3 g in the second cut (Said-Al Ahl et al., 2016). In Serbian agro-ecological conditions, the single plant yield in the first growing season was between 72.5 and 81.4 g/plant depending on fertilization and crop density, while in the second year it varied between 151.1 and 221.9 g/plant (Radanović et al., 2018).

Figure 2 shows initial and final plant moisture for the investigated plants. The water content in fresh plant material was also the highest in *D. moldavica* (74.8%), followed by *N. cataria* var. *citriodora* and *S. montana* (69.5 and 67.8%, respectively). Investigation conducted in Croatia, with wild *S. montana* collected in the winter period, showed the initial water content of 80.1% (Dudaš et al., 2013a). In the case of the final moisture (water content in dry plant material), the situation is different: the highest value is noted for *S. montana* (11.5%), then *D. moldavica* (9.3%), and the lowest value was for *N. cataria* var. *citriodora* (7.7%). The final moisture is important for plant material storage. Generally, drying treatment is conducted to preserve the plants by removing the water (Mediani et al., 2014).

The moisture content in medicinal plants at the end of the herb drying process must be 10–14%. With this moisture content, most of the drugs can be stored for a longer period without damage (Poós & Varju, 2017). Figure 3 shows moisture and drying indices for the selected plants. As depicted, moisture content in dry *S. montana* plants was 5.9 times lower than in the initial plant material, while in *D. moldavica* and *N. cataria* var. *citriodora* it was 8- and 9-times lower in comparison to the initial plant material. Further, 2.8 kg of fresh *S. montana* herbs is required for obtaining 1 kg of dry plant material, similar to *N. cataria* var. *citriodora* (2.9 kg), while in the case of *D. moldavica* it is

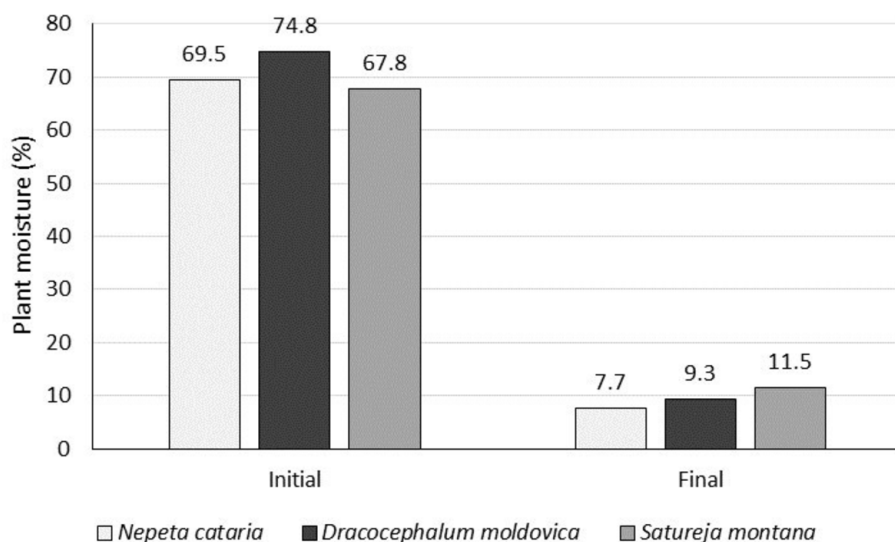


Figure 2. Initial and final moisture in plants from *Lamiaceae* family

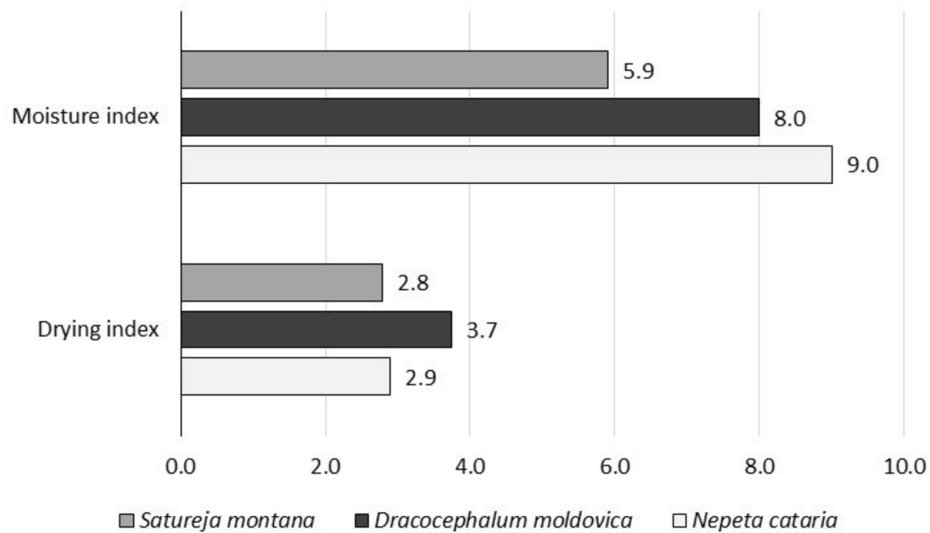


Figure 3. Moisture and drying index for the plants from *Lamiaceae* family

Table 1. Coefficients of variation (%) for the investigated traits in the plants from *Lamiaceae* family

Traits	<i>Nepeta cataria</i>	<i>Dracocephalum moldovica</i>	<i>Satureja montana</i>
Fresh weight	8.5	11.1	12.8
Dry weight	8.4	15.9	10.2
Initial moisture	0.6	1.9	0.2
Final moisture	1.1	3.5	1.7
Moisture index	0.9	3.4	1.7
Drying index	10.0	7.3	2.7

3.7 kg. Radanović et al. (2018) reported that loss of moisture upon drying of harvested aboveground parts of *S. montana* was estimated by the ratio between fresh and dry herbal material; it ranged between 2.4-2.9 : 1 in the first and 2.0-2.1 in the second experimental year of the research. Similarly to these data, the ratio between fresh and dry plant material of *S. montana* in Croatia ranged between 2.4 and 3.0 (Dudaš et al., 2013b).

The coefficients of variation for the investigated parameters were in the expected range (Table 1). Lower coefficients calculated for initial and final moisture, and moisture index, indicate uniform moisture content in plants that vary in weight.

CONCLUSION

During the drying process, plant weight decreased 3.7-, 2.9- and 2.8-times for *D.*

moldovica, *N. cataria* var. *citriodora*, and *S. montana*, respectively, however variation for all tested parameters indicates a uniform moisture content in plants which vary in weight. The results could be useful in estimating the yield of dried herb which has a market value, based on the weight of the freshly harvested plants.

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SAŽETAK

Dracocephalum moldavica, *Nepeta cataria* var. *citriodora* I *Satureja montana* – PROCENA PRINOSA SUVOG BILJNOG MATERIJALA U AGROKOLOŠKIM USLOVIMA SRBIJE

MILICA AĆIMOVIĆ, MILKA BRDAR-JOKANOVIĆ, BILJANA KIPROVSKI

Dracocephalum moldavica L., *Nepeta cataria* L. var. *citriodora* (Becker), i *Satureja montana* L. (familija *Lamiaceae*, subfamilija *Nepetoideae*) su lekovite i aromatične biljke, koje se uglavnom koriste u medicini, farmaceutskoj i prehrambenoj industriji. Cilj ovog istraživanja je procena prinosa suvog biljnog materijala dobijenog žetvom nadzemnih delova odabranih biljnih vrsta. Drugi cilj istraživanja je da se utvrdi korelacija između parametara merenih u svežem i suvom biljnom materijalu. Masa sveže biljke se smanjuje nakon sušenja: 3,7; 2,9 i 2,8 puta kod *D. moldavica*, *N. cataria* var. *citriodora* i *S. montana*, po redosledu. Ovi rezultati odnosno vrednosti indeksa sušenja pokazuju koliko kilograma svežeg biljnog materijala je potrebno za dobijanje 1 kg suvog. Sadržaj vlage je 8,0; 9,0 i 5,9 puta veći u svežem biljnom materijalu u poređenju sa suvim kod *D. moldavica*, *N. cataria* var. *citriodora* i *S. montana*. Varijacije svih ispitivanih parametara ukazuju na ujednačen sadržaj vlage u biljkama koje variraju u težini. Ova zapažanja mogu pomoći uzgajivačima lekovitog bilja da procene prinos suvog biljnog materijala ispitivanih biljnih vrsta odmah nakon žetve.

KLJUČNE REČI: macina trava, masa biljaka, planinski čubar, sadržaj vlage, zmajeglavka

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