Behaviour of Monarda didyma species cultivated under the soil and climate conditions of the Didactic Station in Timişoara, Romania

Bojinescu(căs. Botoş) FLORINA-NICOLETA, Pop GEORGETA

Universitatea de Stiințe Agricole și Medicină Veterinară a Banatului „Regele Mihai I al României" din Timișora, Romania
getapop_tm@yahoo.com

Abstract:*Medicinal plants are a category of plant species that accumulate, in certain parts of the plant, various active principles useful in treating various conditions. Medicinal plants in various forms have served health since the beginning of the world. With the development of the chemical industry, some popular remedies have been given a different form, have been modernized. Most of the time, the effect of using medicinal plants is slow, requiring longer, but less risky and cheaper treatment. The effect of medicinal plants is more complex, acting on several organs or systems concurrently. Medicinal plants have fewer and much lower side effects. [Pop G. 2001, Fraternale D. 2006,Lawrence B.M.]. Therapeutic essential oils are very concentrated natural substances; they are volatile, biologically active and very effective from a therapeutic point of view. Essential oils are obtained from plants by a method of distillation in most cases, under special conditions of pressure and temperature. Following this process, the plants release some volatile biologically active components from their flowers, leaves, branches, roots, bark or seeds. [Baratta M.T1998, , Burt S.2004, Dean S. G. 1987]. Most essential oils contain components with antibacterial, antifungal, antiviral, anti-inflammatory, and antioxidant properties. Monarda didyma is an herbaceous plant, whose healing properties were known in Antiquity. The flower is often used as a medicine, as well as added to food in the form of spices. Monarda didyma came to our country in the 19th century and, for a long time, it had a decorative purpose. Today, the plant is widely used for treating various conditions, for strengthening the immune system, and for solving cosmetic problems. It is a very useful plant. [Rus C.F. 2013, Bojor O. 2009]. The name of this genre was given by the 18th-century physicist and Swedish physician, Karl Linné, in honour of the Spanish researcher and doctor Nicholas Monardes of the 16th century, who published a 1574 paper on new plants of America. [Yvone Y. 2012] Genus: Monarda, Family: Lamiaceae (alt. Labiatae), Subfamily: Nepetoideae, Tribe: Mentheae, Subtribe: Menthinae. The plant contains biologically active compounds and auxiliary components. Bioactive elements are turpentines – substances in the composition of essential oil [Bojor O. 2005, Suhaj M. 2006]. Some varieties of Monarda didyma contain characteristic substances that mimic the taste and smell of peppermint and lemon. It has been scientifically proven that prolonged use of Monarda didyma -based drugs is not dependent. The comprehensive treatment of a number of diseases with this plant and antibiotics accelerates recovery.*

Keywords: *Monarda didyma, essential oil, dry herba, soil and climate conditions*

INTRODUCTION

The genus Monarda is very promising as a source of active antifungal substances, against the representatives of the three genera of fungi (*Aspergillus, Penicillium, and Mucor*), which can generate mycotoxins and poison through food, as well as against pathogens that cause fungal diseases, in particular, *Trichophyton mentagrophytes*, causing zoster herpes in humans and worms in animals. [CAROVIC-STANKO K. 2010, BAKKALI F. 2008, BARRERA-NECHA L. 20097].

The essential oil of *Monarda didyma* is used to treat burns, eczema, and hair loss. For treatment, you can take pure essential oils, as well as infusion, leaf juice, and inflorescences. Baths also contribute to the healing of wounds, ulcers, and eczema. *Monarda didyma* is also helpful in case of acne, seborrhoea, and peeling of the skin.

Monarda didyma has proven promising for special recreational areas (i.e., hospitals, clinics, and playgrounds. [KALAMOUNI C. 2010].

A significant improvement in the indoor air environment can be achieved by the use of plant species for their "greening ", whose volatile emissions have pronounced properties of phytoncide nature. In this regard, it is recommended to use phytoncide plants in rooms to improve the environment. Already at a concentration of 5 mg/m³, volatile emissions can change and improve the environment. *Monarda didyma* essential oil reduced air contamination by staphylococcus, streptococcus, diphteric, and pertussis 10 times. [EDRIS A.E. 2003]

The effect of *Monarda didyma* essential oil on the activity of metabolic processes, cell division speed and the state of cytoplasmic membranes has also been studied. Treated with *Monarda didyma* essential oil, the cardiovascular system reduces the intensity of DNA synthesis, and permeability of lymphocytes membranes decreases.

The number of viable lymphocytes is not reduced. When adding essential oil to fibroblasts culture, the 0.5% emulsion leads to their death and the 0.005-0.0005% emulsion stimulates the growth and division of these cells. [ALBAYRAK S., 2013].

Medicinal plants are a category of plant species that accumulate, in certain parts of the plant, various active principles useful in treating various conditions.

Medicinal plants in various forms have served health since the beginning of the world. With the development of the chemical industry, some popular remedies have been given a different form, have been modernized. Most of the time, the effect of using medicinal plants is slow, requiring longer, but less risky and cheaper treatment. The effect of medicinal plants is more complex, acting on several organs or systems concurrently.

Therapeutic essential oils are very concentrated natural substances; they are volatile, biologically active and very effective from a therapeutic point of view. Essential oils are obtained from plants by a method of distillation, in most cases, under special conditions of pressure and temperature. Following this process, the plants release some volatile biologically active components from the flowers, leaves, branches, roots, bark, or seeds. [BARATTA M.T., 1998, BURT S., 2004, DEAN S., 1987].

MATERIAL AND METHOD

The Didactic Station in Timisoara, Romania, is, from a geomorphological standpoint, part of the great physico-geographical unit "Banat-Crișana Plain".

The Didactic Station is located in the south-western part of the country, benefiting from the moderate continental climate, with shorter and milder winters, is frequently under the influence of the activity of cyclones and hot air masses from the Mediterranean and Adriatic Seas.

From the map of climate types in Romania, it follows that the perimeter of the Didactic Station is within the moderate continental climate, at the interference between the climate provincial sector with ocean influence and the climate provincial sector with sub-Mediterranean influences.

The annual average temperature is 10.7°C, with average multi-annual fluctuations from several subunits up to 1.0-1.2°C.

The multi-annual average of rainfall at the Meteorological Station in Timisoara is 631 mm.

The climate data recorded by the Timişoara Meteorological Station to which we refer by analogy are the values of temperature during the experimental period (10.850C), with an additional 0.150C compared to the multi-annual average.

With regard to precipitation, the multiannual average is 608 mm. Quantities above than the average were recorded in 1954 (909 mm), 1967 (911 mm), and 1971 (920 mm). Quantities of rainfall below the multiannual average were recorded in 1950, 1953, 1983, 1984, 1992, 1993, and 1995, all having less than 500 mm. The average amount of precipitation fallen during the

experimental period was 630 l/m2, with an additional 22 l/m2 compared to the multi-annual average.

The biological material was produced by the Brasov Dacia Plant Station. In 2014, the plants of *Monarda didyma* in the form of rooted cuttings were cultivated in the experimental field located in the "Young Naturalists' Station" in Timisoara. The preparation of the land for the start-up of the culture was achieved by the soil works specific to cultivation technology.

The rooted seedlings were planted on October 3, 2014, at a distance of 70 cm between rows and 40 cm between plants. The species *Monarda didyma* was maintained in culture until 2016. In November, the rooted seedlings were transplanted into the experimental field of the Timisoara Didactic Station. In *Monarda didyma* culture, maintenance works were carried out to control weeds through mechanical works. During vegetation, phenological observations were carried out (flowering completed, all over the month of June).

Herba was harvested starting with the second decade of June, when 50% of the plants flourished. After harvesting, the plants dried in the shade, after which they were shredded, processed, and prepared for the extraction of essential oil.

Cultivation technology. The seeds of *Monarda didyma* germinate at a temperature of about 20°C.

With the advent of flowering at the end of June-early July, growth ceases.

Monarda didyma is quite resistant to cold, which makes it possible to grow it in the cold regions of the country. But clay soils and swamps are not favourable to culture.

It grows better in open places with light.

On the soil where *Monarda didyma* grows, it is necessary to ensure the optimum humidity for the culture.

It requires fertilization with mineral and organic fertilisers to ensure the need for nutrients in the growth and development of plants until flowering.

Legumes grown for grains are recommended as pre-emergent plants. Fertilisers must be applied before planting. It is possible to use manure, but not fresh, with phosphorus fertilizers as well as fertilisers containing potassium.

When multiplied by seeds, it is necessary to produce seedlings.

Account should be taken of the fact that, in the early stages of vegetation, germs have a very slow increase.

In warm regions, *Monarda didyma* is seeded directly into open terrain and presents good germination. In this case, the seeds strengthen, and the specimens that survive will become vigorous, resilient, and healthy plants.

Separating a flavour from its natural environment is a difficult problem because it must be isolated or concentrated with minimum loss and composition changes, and without impurities. All inappropriate operations cause degradation of natural composition. [SUHAJ M., 2006, TOROGLU S., 2011].

Volatile oils are distributed throughout the plant or, more often, accumulate in an organ of it. [WINK M. 2003, YILMAZ O., 2012].

As for production share, the following extraction processes are currently used: vapour training, fat extraction, extraction with organic solvents, extraction with supercritical fluids, pressing, and absorption on solids.

RESULTS AND DISCUSSION

Essential oils were obtained by continuous hydro-distillation (Soxhlet extraction) in the laboratory of the Interdisciplinary Research Platform, "Ecological, Sustainable Agriculture and Food Safety". The boiling water balloon and the storage balloon of the plant material have a capacity of 2 l. To obtain essential, dried herba (Herba Monarda) was distilled using an amount

of plant material of 280-300 g/sample. At the time of boiling, water vapours penetrate the herba, destroy the coating of the oleiferous glands, volatilize the oil, and then mixes with it. The boiling time of a sample was approx. 30 minutes after passing the first steam through the dry herba mass. The essential oil extracted was stored in the refrigerator at a temperature of 4°C in brown bottles until use.

Following the processing of dry plant material (Herba Monarda) by the method described above, the yield of essential oil obtained is shown in Table 1.

Table 1.

Amount of essential oil obtained from dry Herba Monarda in 2018 (ml)

Species	M.U.	Amount of oil extracted
Monarda didyma – dry herba	g	282
Essential oil	ml	10

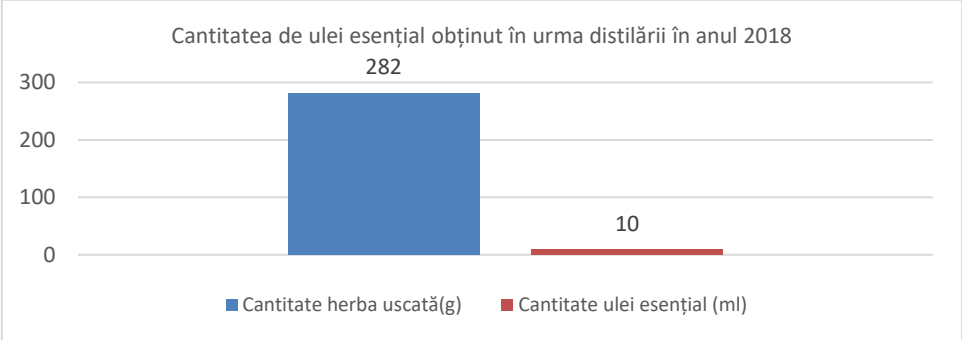

Fig. 1. Amount of essential oil obtained from dry Herba Monarda in 2018 (ml)

Figure 1 shows that, in 2018, from the total amount of dry herba of 282 g, 10 ml of essential oil was obtained by Soxhlet extraction method.

Table 2.

Amount of essential oil obtained from fresh Herba Monarda in 2019 (ml)

Species	M.U.	Amount of oil extracted
Green herba (leaves and flowers only)	g	300
Essential oil	ml	2

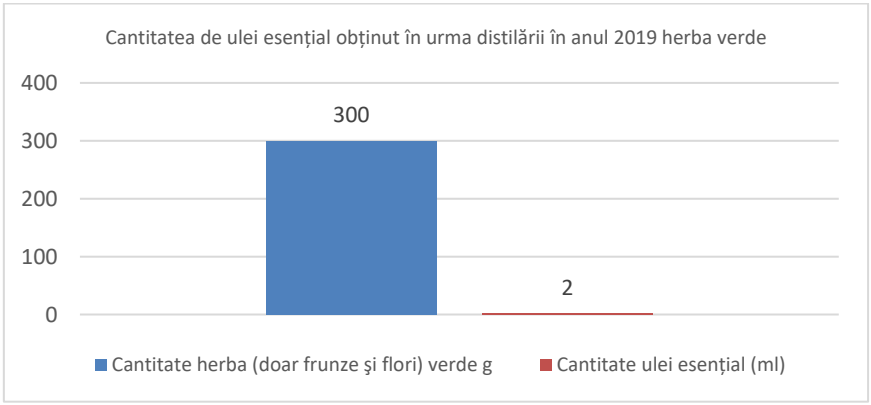

Fig. 2 Amount of essential oil obtained from fresh Herba Monarda in 2019 (ml)

In Figure 2, in 2019, compared with 2018, measurements were made in green herba (leaves and inflorescences) by the Soxhlet Hydro-distillation method and 2 ml of essential oil was obtained from 300 grams of green herba.

Table 3.

Amount of essential oil obtained from dry Herba Monarda in 2019 (ml)

Species	M.U.	Amount of oil extracted
Dry herba	g	300
Essential oil	ml	6

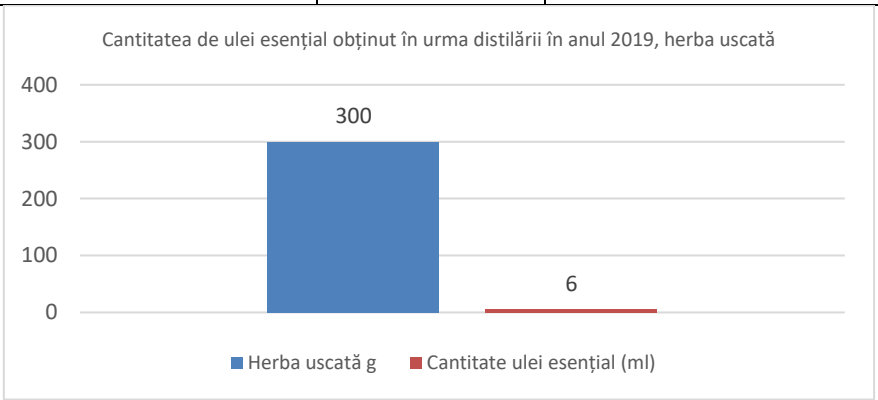

Fig. 3. Amount of essential oil obtained from dry Herba Monarda in 2019 (ml)

Figure 3 shows that the amount of essential oil obtained from dry herba (the whole plant yielded 6 ml of essential oil, a decrease of 2 ml content compared to 2018, is also caused by the fact that the bushes were separated into cuttings that were subsequently replanted, which affected the essential oil content.

Essential oil is considered the most valuable: its properties are used successfully both in medicine and in perfumery.

All the overland parts of the plant contain up to 3% essential oil, which is concentrated mainly in leaves and inflorescences, and in its small stems, the concentration of essential oil is not greater than 0.06-0.08%.

Double *Monarda didyma* contains oil with a light yellow or red-brown colour and a balsamic-sweet lavender odour. It consists of several components, the ratio of which varies depending on the development phase, the origin of the population and, of course, the species.

However, in the oil of *Monarda didyma*, there are always phenols (Timol, Carvacrol, P-cymol), Sabinen, Cineol, Terpinen, Limonene, Myrcene. Therefore, the smell of oil often resembles thyme or oregano. The only exception is *Lemon Monarda (Monarda citriodora),* which was named after its smell.

CONCLUSIONS

- Monarda didyma is a heat and light loving plant;
- Climate conditions in the experimental years 2018-2019 had a favourable influenced on the cultivation of the *Monarda didyma* plant;
- Soil conditions in the experimental field of the Didactic Station in Timişoara are optimal for the fertility of the species *Monarda didyma*;
- In 2018, of a total amount of dry herba of 282 g, 10 ml of essential oil was obtained;
- In 2019, compared with 2018, 2 ml of essential oil were obtained from 300 g fresh herba. The decrease in the essential oil content compared to 2018, was caused by

the fact that the bushes were separated into cuttings that were subsequently replanted (the plants were in the first cultivation year);

- The spring of 2019 was rainy with lower temperatures, with unfavourable influence on the growth and development of plants, which resulted in a weaker degree of flowering of the crop of *Monarda didyma*, which resulted in a smaller amount of essential oil.
-

BIBLIOGRAPHY

POP G., NIŢĂ S., IMBREA F., MOCIOI I. 2001 - Lucrări practice de Fitotehnie, Ed.Mirton, Timişoara.

FRATERNALE, D.; GIAMPERI, L.; BUCCHINI, A.; RICCI, D.; EPIFANO, F.; BURINI, G.; CURINI, M. 2006, Chemical composition, antifungal and in vitro antioxidant properties of *Monarda didima L.* essential oil. J. Essent. Oil Res., 18, 581-585.

LAWRENCE B.M.1992 - Chemical components of Labiatae oils and their exploitation. In: Harley R.M., Reynolds T. (eds): Advances in Labiate Science. Richmond, Royal Botanic Gardens Kew: 399-436.

BARATTA, M. T., DORMAN, H. J. D., DEANS, S. G., FIGUEIREDO A. C., BARROSO, J. G. AND RUBERTO, G. 1998. Antimicrobial and antioxidant properties of some commercial essential oils. Flavour Fragrance J. 13: 235-244.

BURT, S. 2004. Essential oils: Their antibacterial properties and potential applications in foods - A review. Int. J. Food Microbiol. 94: 223-253.

DEANS, S. G. AND RITCHIE, G. 1987. Antibacterial properties of plant essential oils. Int. J. Food Microbiol. 5: 165-180.

CAROVIC-STANKO K., ORLIC S., POLITEO O., STRIKIC F., KOLAK I., MILOS M., SATOVIC Z. 2010 - Composition and antibacterial activities of essential oils of *Seven Ocimum Taxa*. Food Chemistry, 119: 196-201.

BAKKALI, F., AVERBECK, S., AVERBECK, D. AND IDAOMAR, M. 2008. Biological effects of essential oils - A review. Food Chem. Toxicol. 46: 446-475.

BARRERA-NECHA, L. L., GARDUNO-PIZANA, C. AND GARCIA-BARRERA,J. 2009. In vitro antifungal activity of essential oils and their compounds on mycelial growth of *Fusarium oxysporum f. sp. gladioli (Massey) Snyder and Hansen*. Plant Pathol. J. 8: 17-21.

KALAMOUNI, C.; DOBRAVALSKYTE, D.; RAYNAUD, C.; VENSKUTONIS, R.; TALOU, T. 2010 - Native vs extracted essential oil: From chemical composition to biological activities. Royal Soc. Chem., 326, 369-378.

EDRIS, A. E. AND FARRAG, E. S. 2003. Antifungal activity of peppermint and sweet basil essential oils and their major aroma constituents on some plant pathogenic fungi from the vapor phase. Food/Nahrung 47: 117-121.

ALBAYRAK S., AKSOY A., ALBAYRAK S., SAGDIT O. 2013 - in vitro antioxidant and antimicrobial activity of some Lamiaceae species. Iranian Journal of Science and Technology Transaction A-Science, 1: 1-9.

CRISTIAN FLORIN RUS, GEORGETA POP 2013- study regarding the quantity of essential oil obtained from different species from the lamiaceae herbal family, Research Journal of Agricultural Science, 45 (3).

BOJOR O., POPESCU O. 2009 - Fioterapie tradiţională şi modernă, Ed.FIAT LUX, Bucureşti.

BOJOR, O., POPESCU, O.,2005 – Fitoterapie tradiţională şi modernă, Editura FiatLUX, Bucureşti,

YVON Y., RAOELISON E.G., RAZAFINDRAZAKA R., RANDRIANTSOA, ROMDHANE M., CHABIR N., MKADDEM M.G., BOUAJILA J. 2012 - Relation between chemical composition

or antioxidant activity and antihypertensive activity for six essential oils. Journal of Food Science, 77: H184-H191.

SUHAJ M. 2006 - Spice antioxidants isolation and their antiradical activity: a review. Journal of Food Composition and Analysis, 19: 531-537.

TOROGLU S. 2011 - In-vitro antimicrobial activity and synergistic/antagonistic effect of interactions between antibiotics and some spice essential oils. Journal of Environmental Biology, 32: 23-29.

WINK M. 2003 - Evolution of secondary metabolites from an ecological and molecular phylogenetic perspective. Phytochemistry, 64: 3-19.

YILMAZ O., AKKAYA H. 2012 - Radical scavenging, activity of *Thymbra spicata* and *Quercus ithaburensis* in a fenton reagent environment and their protective effects on unsaturated fatty acids. Ekoloji, 21: 34-40.