CULTIVATION AND EXTRACTION OF VOLATILE OILS OBTAINED FROM NEW VARIETIES OF BASIL (*OCIMUM BASILICUM L., FAM. LAMIACEAE*)

CULTIVAREA ŞI EXTRACŢIA ULEIURILOR VOLATILE OBŢINUTE DIN SOIURI NOI DE BUSUIOC (*OCIMUM BASILICUM L., FAM. LAMIACEAE*)

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Abstract. *The paper presents the experimental research carried out within INMA Bucharest regarding the cultivation of two new varieties, 'Aromat de Buzau' and 'Serafim', created by SCDL Buzau. These belong to the two varieties of basil (Ocimum basilicum L., Lamiaceae) yellow and purple, which were grown in the agricultural years 2017 and 2018, years that were different in terms of agrometeorological conditions. It also presents the method for obtaining vegetal extracts (volatile oil and floral water), obtained by processing the vegetal raw material while applying a process based on water vapour pressure distillation. Extraction yields obtained are presented comparatively. The results are the premises for obtaining new products with a high market value, which can be applied in the future for vegetable crops protection in greenhouses and solariums.*

Key words: basil, Aromat de Buzau, Serafim, extraction, volatile oils, floral waters

Rezumat. *Lucrarea prezintă cercetările experimentale realizate în cadrul INMA Bucureşti, referitoare la cultivarea a două soiuri noi, 'Aromat de Buzau' şi 'Serafim', create de SCDL Buzău. Acestea aparţin celor două varietăţi de busuioc (Ocimum basilicum L., fam. Lamiaceae) galben şi violaceu, ce au fost cultivate în anii agricoli 2017 şi 2018, ani diferiţi din punct de vedere al condiţiilor agrometeorologice. De asemenea, este prezentată metoda de obţinere a unor extracte vegetale (ulei volatil şi apă florală), obţinute prin prelucrarea materiei prime vegetale, printr-un procedeu ce are la bază distilarea cu vapori de apă sub presiune. Se prezintă comparativ randamentele de extracţie obţinute. Rezultatele constituie premisele obţinerii unor produse noi cu valoare de piaţă ridicată, care se vor putea aplica pe viitor în protecţia culturilor legumicole din sere şi solarii.*

Cuvinte cheie: busuioc, Aromat de Buzău, Serafim, extracţie, uleiuri volatile, ape florale

INTRODUCTION

Culture of basil is known and appreciated in Romania from ancient times,

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both because of the medicinal, culinary properties, but also of the spiritual symbolism that this plant has. Basil is grown today in many other parts of the world (France, Egypt, Hungary, Morocco, USA, Greece, Israel).

Currently, at least 150 varieties are grown, each with its own type of volatile oil, characterized by its distinctive flavor. Depending on the chemical composition of the oil, basil has three biochemical profiles:

- Basil grown in Europe (french basil, sweet, garden) and America have the major components of volatile oil represented by: 4-5% eugenol, 2-3% of methylchavicol (estragol), very good quality linalool at least 50%, with a fine aroma and without camphor;
- Common African basil, indian basil - with major methylchavicol (estragol) 50-70%, linalool 8-30% and camphor content;
- Basil with high content of eugenol (Viturro *et al.*, 1999).

Oil obtained by water vapor entrainment from leaves and floral peaks differs depending on the chemotip from which the raw material originates. More than 200 chemicals have been reported in basil oil, including monoterpenes, triterpenes, sesquiterpene, flavonoids and aromatic compounds. Major components of basil oil include: linalool, estragol (methyl chavicol), anethole, eugenol and methyl eugenol (Qing *et al.*, 2016).

MATERIAL AND METHOD

The plant material used for the establishment of the crop was represented by seedlings belonging to new varieties (creations of SCDL Buzau) from two varieties of basil:

- ***'Aromat de Buzau'*** variety, that belongs to Yellow Basil variety (Homologation Certificate no. 1367 / 22.03.2006)
- ***'Serafim'*** variety, that belongs to Violaceous Basil variety **(**Homologation Certificate No. 4432 / 22.05.2017)

The main characteristics of the ***'Aromat de Buzau' variety*** (Burnichi *et al.,* 2014) (fig. 1.a): Semi-varieties, with are well defined genetic constitution, very well adapted to the environmental conditions existing in our country. The variety is easily recognizable due to its specific flavor, but also by distinct characters: the color of the leaf, the length of the shoots, the ability to preserve its properties during the preservation period. The mature plant is in the form of a strongly branched, slightly flowing bush with a height of 40-60 cm; The leaves are oval, slightly pointed at the top, light green; Flowers are white, somewhat rarer than those of common basil, and the fruits (seeds) are very small (600-800 seeds/g), black and with a high storage capacity without greatly diminishing germinative ability (4-6 years). From the point of view of the relationship with the environmental factors there are no special requirements, preferring the fertile and heavily sunny soils. Cultivation technology supports great flexibility depending on the purpose of the crop and can be cultivated both by direct sowing and seedling. The variety can be grown in an ecological system, and due to the flavor that the plant releases through all its organs there are no losses caused by diseases or pests. Average shoots production is around of 10 - 12 t / ha. The main characteristics of the ***'Serafim' variety*** (Burnichi *et al.,* 2014), (fig. 1.b): Semi-sweet variety, a variety of red-violet basil with an unknown cross,

blooming from summer to autumn. Plant width: 60-70 cm, diameter of the bushes: 40-45 cm, richly branched, with slightly jagged leaves. Unusual, strong, purple-purple color is due to the high content of anthocyanins. The flower has pink-violet corolla, seeds are elliptic 2/1 mm, black color - slightly brown, mate, MMB = 1.3 g, at 1 g = 750 seeds with high storage capacity (4-6 years) without diminishing their germination. It can be used for culinary, ornamental and medicinal purposes, and it is also possible to use it in the perfume industry due to the very pleasant flavor of cloves. It can be cultivated successfully in protected areas, in the open field, but also in the pots. An average yield is about 9 - 10 t ha.

Fig.1.a Yellow Basil *'Aromat de Buzau'* variety

Fig.1.b Violaceum Basil *'Serafim'* variety

In order to obtain the volatile oils and the flood waters of basil, the Hydraulic distillation (pressure water vapor distillation from a separate generator) was used as a method, using a french-based installation, AURA DISTILLATEUR, with a main tank capacity of 130 liters.The extraction yield was calculated using the formula:

Extraction yield (ml/kg) = V/M,

where: V = the volume of essential oil obtained from the plant sample (mL);
M = sample mass of herbs (kg).

The institution where the research was conducted was HORTING Bucharest, and the research method used to obtain the volatile oils was Hydrodistillation (distillation with water vapor under pressure).

RESULTS AND DISCUSSIONS

On the existing land at INMA Bucharest (Baneasa area), under the climatic conditions of the years 2017 and 2018, on a brown-red soil of the forest, the crops with the two basil varieties were established by planting seedlings procured from SCDL Buzau. From an agro-climatic point of view, 2017 was characterized on average by an increase in temperature by 0.7°C above normal climatic (1981-2010). The amount of precipitation accumulated in 2017 was 6% higher than normal climatological (1981-2010). Decreases in rainfall were positive in four of the 12 months of the year under review, ranging from 2% in February to 73% in October, while negative deviations were recorded over the next four months, January, March, June and August, ranging from 12% in March to 37% in January (2017 Report-NMA). For 2018, the average air temperature exceeded by 1.35°C the climatological norm in force (multi-annual average 1981-2010). In 2018 there were 9 months with positive monthly thermal

deviations between 0.3 and 4.7°C, compared to the period 1981- 2010, important in terms of the plant vegetation period, being the moons (+2, 2°C), June (+ 0.9°C), August (+ 1.8°C), September (+ 1.1°C), October (+ 2.0°C). The amount of rainfall for this year was 698.8 mm, 10% higher than normal climatological (1981-2010). Monthly precipitation declines were negative, oscillating between 6% in November and 64% in April (Communique 2018-ANM).

The crop technology applied to the two new varieties of basil included the following technological links:

• *The basic fertilization* was done with the autumn spring, when organic fertilizers (40 t/ha of manure) and mineral fertilizers (phosphorus 40-50 kg / ha and 30-40 kg / ha sa).

• *Soil works* began in the spring before planting, when the land was worked with the grower and the harrow, to maintain moisture in the soil and to remove ephemeral weeds. Even though basil is not too pretentious to the type of soil, however, it needs to be loosened and well mobilized.

• *Establishment of the basil culture* (in both cases) was done by seedlings. For the production of seedlings it sowed in the second decade of March in multiplier greenhouses, using approx. 6 g seeds / m^2. The care work on seedlings was the usual. The seedlings needed for the area of 200 square meters (area of the experimental lots) were produced by sowing directly in the alveoli in greenhouses, by SCDL Buzau.

• *Seedling planting* was done in the field early in May using a planting scheme: 1.00 m/between the lines (for mechanization of maintenance) and 35-40 cm between plants in the row, so that the areas of 2 × 200 m about 1,200 pieces were planted. seedlings of Yellow Basil, variety *'Aromat de Buzau'* and Violaceous Basil, *'Serafim'*, variety.

• *Maintenance work* consisted of manual and mechanical drills. The first hoeing manual has been executed after the operation of planting the seedlings, and the following hoeing were executed whenever needed, both for combating weeds between the rows of plants/from plants in the row, but also for loosening the soil and combating crust formed around the plants. The main weeds found in culture were the ephemeral: like *Veronica sp*., Buckwheat climbing - *Polygonum convolvulus*, then weeds summer: Gloomy - *Setaria sp.*, Pigweed - *Amarantuhus retoflexus*; Bindweed - *Convolvulus arvensis*, Greasy grass - *Portulaca oleracea.* They were the main problem and were eliminated by manual and mechanical works, the culture is kept "clean" without the application of synthetic chemicals.

•*Watering* was done whenever it was needed (especially in August that was a water-scarce month), with watering norms=300-400 m^3 of water, using sprinkling. Noteworthy, that in the climatic conditions of the year 2018, July was a very rainy month with norms above average, which negatively influenced vegetative growth and development (implicitly the accumulation of volatile oils) for both varieties of basil.

• *Harvesting* was done following the degree of accumulation of volatile oil in

plants, when on the central inflorescence, the verticals at the base have brownish-red fruits. This work was staggered, obtaining 2 crops (in August and early October). In bothcases, the work was done mechanically, in sunny weather, using a Herbal Harvesting Equipment, an experimental model, the creation of the institute. After the production of the vegetable raw material, the following step was carried out: the production of volatile oil and floral water from the two basil varieties, 'Aromat de Buzau' and 'Serafim' using french-derived plant (Aura Distilllateur). For this, the plant material must meet technical reception conditions: no organic foreign bodies are allowed, the maximum permissible admissible level of impurities must be max. 5% (floral stems, brunched flowers), mineral alloys max. 0.5%, max. 11% (Verzea, 2002). At the start of the drive operation, when the plant product is rich in volatile oils, steam production was moderate, cooling the strong refrigerant and condensing rapidly to avoid losses. When distillation is done too quickly, water vapor drives less volatile oil. The first portions of distillate contain the largest amount of hydrophilic principles: aldehydes, alcohols, acids, etc. and have a pleasant flavor. The following portions are opalescent, have a less pleasant aroma and contain terpenic hydrocarbons, which are hardly soluble in water. The end of hydro destillation is marked by the lack of odor of the distillate. The collected distillate mixes well (by stirring) to make a saturated solution, and the excess volatile oil is collected at the surface of the Florentine vessel (oil separator). By the hydrodynamic procedure of the two basil varieties, a distillate, consisting of a volatile / essential oil and floral water, called the hydrolyte (a mixture of volatile/essential oil and floral water) was obtained, which was then separated. It is worth anyting that both the quantity and especially the quality of the volatile/essential oil and the floral water obtained differ according to the type of soil and especially the agro-climatic conditions of the respective production year. Once obtained, they were stored in dark glass containers, clean and sterilized at low temperature. Table 1 shows the field culture technology of basil (both varieties).

Table 1

Technological data sheet of basil culture

Technological sequence	Yellow Basil variety ***'Aromat de Buzau'***	Violaceous Basil variety ***'Serafim'***
Destruction of plant remains	tractor of 55–75 CP in aggregate with the disk harrow and adjustable harrows	
Fertilization	in order to ensure permanently the nutritive elements which are necessary for plants. Basic fertilisation with organic/chemical composts is made with a 55-75 CP tractor in aggregate with the machine which furnishes organic/chemical composts	
Ploughing	depth 23-25 cm if the soil is humid enough, with a tractor of 55–75 CP in aggregate with plough and star-toothed horrow or disk harrow and adjustable harrows	
Maintenance ploughing	multiple disking in order to maintain the field without weeds	

Preparing germination bed	is made with a tractor of 55–75 CP in aggregate with combinator	
Planting	at the beginning of May, daily temperatures reaches values over 17ºC. Is made when the seedling have 6-7 cm hight.	
Culture irrigation	are made in order to ensure the water necessary during the growth an flowering periods	
Harvest	when 25-30% of plants had flowered, by cutting the airy part at 8-12 cm up from the soil. Can be realised 2-3 harvests/an	
Extracţ ion yield	5 mL of volatile oil/1 kg of vegetable material	1 mL of volatile oil/1 kg of vegetable material

CONCLUSIONS

1. The two varieties taken in crop are valuable varieties, and crop technology does not involve high cost to the surface unit. The yields obtained are large at the surface unit (10 - 12 t / ha).

2. The yield of extraction depends on the type of plant and the distillation time, and 1 kg of the plant produces 1 liter of hydrolysate. The extraction yield obtained for the two basil was 1 mL of volatile oil/1 kg of vegetable material for *Violaceum Basil* - 'Serafim' variety and 5 mL of volatile oil/1 kg of vegetable material for *Yellow Basil* - *'Aromat de Buzau'* variety.

3. The volatile oils and floral waters that are obtained are of superior quality with quality chemical compounds (linalol, estragol, eugenol), search and use in the perfume and cosmetics industry.

4. It is also possible to create the premises for obtaining new products with high market value, which can be applied in the future in the protection of greenhouse crops in greenhouses and solariums.

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