

ANNALS of Faculty Engineering Hunedoara – International Journal of Engineering

Tome XIV [2016] – Fascicule 3 [August]

ISSN: 1584-2665 [print; online]

ISSN: 1584-2673 [CD-Rom; online]

**a free-access multidisciplinary publication
of the Faculty of Engineering Hunedoara**



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SUPERIOR CAPITALIZATION OF LAVENDER BY OBTAINING VOLATILE OILS APPLYING THE STEAM DISTILLATION METHOD

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ABSTRACT: This paper aims to provide a rich and updated information on certain aspects regarding the necessity of establishing of lavender crops, to highlight the large palette of use the products, which can be obtained from this plant and not least, the material benefits. The paper is addressed to specialists, farmers, to the family associations, highlighting the most important aspects to obtain quality products, and under favorable economic conditions.

Keywords: lavender, technology, volatile oil, distillation floral water

1. INTRODUCTION

Considered as small shrub, Lavender is a perennial plant, having leaves even in winter. Usually the leaves are silvery green, but there are also varieties with green or silvery leaves. The culture of lavender reaches maturity in 2-5 years, and it can be operated without problems for 30-40 years.

In Romania the most common variety of lavender is that with narrow leaves, which have a width of 3-4 mm and a length of 30-40 mm called *Lavandula angustifolia*. To achieve a lavender plantation over an area of 1ha, are necessary about 18,000 to 19,000 seedlings reaching maturity after 3 years, and the production may reach 4000-4500 kg/ha of green flower (fresh). If the harvesting from summer is properly done, it can also carry out and a second crop in autumn, from which it might still get 1000-1500 kg of lavender flowers.

Among the plants whose chemical composition can generate a significant amount of volatile oils and flower water, the lavender occupies a leading position. From chemical point of view, the volatile oils are complex mixtures of aliphatic and aromatic hydrocarbons, aldehydes, alcohols, esters and other constituents, being predominant the compounds of the terpenoids class. In the past, these oils were called etheric oils, essential oils or aromatic essences.

The extraction of a flavor from its natural environment is not an easy operation. This must be isolated or concentrated with a minimum of losses, modifications of composition and without the introduction of some impurities. Volatile oils can be extracted from various parts of the plant: flowers, seeds, leaves, stems, peels, roots, rhizomes, tubers, floral buds etc.

Although they are called oils, these substances do not contain fatty materials: a drop of essential oil placed on a paper sheet will not leave any trace, as opposed to one of vegetal oil. However, the essential oils properties must not be confused with those of the leaves or flowers of a same plant. Also, must not be confused the essential oils neither with the culinary essences nor with perfumes. Essential oils are highly concentrated in active chemical elements and may present certain risks. Some compounds are aggressive relative to the skin or mucous membranes, others can be toxic in high doses or when used on a long period. As for the domestic use, have to know that some compounds (such as ketones) are toxic and must never be absorbed. In principle, the essential oils must not be

ingested in its pure state. Therefore, when using them must consider the recommendations for use. The soothing properties of the lavender are indicated in the states of hysteria and neurasthenia, of melancholy or anxiety. In such cases, lavender is used in the form of dry powder, which is kept in a hermetically sealed jar.

2. BENEFITS

✓ Benefits of lavender essential oil:

- ≡ the lavender oil has a calming scent, which makes it an excellent tonic for nerves. Therefore helps in treating of migraine, headaches, anxiety, depression, nervous tension and emotional stress. The soft flavor eliminates the nervous exhaustion and anxiety, increasing the mental activity.
- ≡ the lavender oil induces sleep, and therefore, it is often recommended for insomnia.
- ≡ the lavender oil is also an excellent remedy for various types of pains, including those caused by the muscular pains, tense muscles, rheumatism, sprains, backache and lumbago. A regular massage with lavender oil ameliorates the pains in joints.
- ≡ the lavender oil is beneficial for the urinary tract, because it stimulates the urine production. It helps the restoration of the hormonal equilibrium and reduces cystitis or the urinary bladder inflammation. It also reduces any associated cramps.
- ≡ the lavender oil is widely used for various respiratory problems, including throat infections, flu, cough, asthma, sinus congestion, bronchitis, whooping cough, laryngitis and tonsillitis. This oil is used either in the form of vapor, or applied to the skin of the neck, chest and back. It is also added to vaporizers and inhalers for cold and cough.
- ≡ the medical benefits of the lavender oil as regards the skin can be attributed to its antiseptic and antifungal properties. It is used to treat various skin disorders such as the acne, wrinkles, psoriasis and other inflammations. Heals wounds, cuts, burns, sunburn very fast. The lavender oil is added to chamomile for eczema treatment.
- ≡ the lavender oil is a blood circulation stimulant. It lowers the blood pressure and is used for hypertension.
- ≡ the lavender oil is useful for digestion, because it increases the intestine motility. It stimulates the production of gastric and biliary juices thus helping to the treatment of indigestion, stomach aches, colics, vomiting and diarrhea.
- ≡ the regular consumption of lavender oil provides resistance to disease.

Other benefits of the lavender oil include its ability to treat leucorrhoea. It is also effective against insect bites. This oil is also used to reject the mosquito and moths. A number of mosquito repellent contain lavender oil as one ingredient.

The soothing properties of the lavender are indicated in hysteria and neurasthenia states, of melancholy or anxiety. In such cases, lavender is used in the form of dry powder, which is kept in a hermetically sealed jar.

By the method of distillation with water vapor, is obtained also a significant amount of floral water. The resulting water is a hydrolate and contains an average of 2-4% micromoles of essential oils. Lavender hydrolate has similar properties to the essential oils and, having a lower concentration, is highly sought especially in the cosmetics industry.

✓ Benefits of water flowers (of lavender)

The therapeutic qualities of the lavender water are so numerous that it becomes difficult to put them into a selective action field, so: increases the defense power and recovery of the body, has a regenerating action on the epidermis, it is a quick remedy for scratches, wounds, allergic and solar erythema, eczemas, acne, has antiseptic and regenerative power on the tissues.

3. TECHNOLOGIES TO OBTAIN VOLATILE OILS

Industrial extraction of volatile oils from various aromatic herbs is done by different methods depending on their specific qualities. Each method is important and has its place in the production process of essential oils.

The main methods for obtaining the volatile oils are:

- ≡ water vapor distillation;
- ≡ volatile oil extraction with organic solvents;
- ≡ animal fat extraction: enfleurage and maceration;
- ≡ Liquefied gas extraction (supercritical CO₂);
- ≡ extraction by pressure;
- ≡ adsorption on an adsorbent material.

- ✓ *Volatile oil extraction with organic solvents:* applies particularly to obtain of natural fresheners perishable under the temperature influence and that cannot be obtained by processes based on the steam distillation. The operation consists of the exhaustion of vegetable raw material with a solvent and then isolating the odorous principles or aromatics, allowing the evaporation of the solvent by distillation.
- ✓ *Extraction with animal fats:* the use of fats as a medium of extraction of gases and odors from flowers is a technique used exclusively in perfumery, based on the properties of volatile oils of being soluble in fats and on the affinity that the fats have to odors.
- ✓ *Extraction with liquefied gases:* the evolutions in the technological sector and the deepening from physicochemical point of view of the unitary operations made that this process to become industrially applicable. The advantages offered by the liquefied gases are the following: reduced thermal consumption; possibility of excluding the contact with oxygen; the inexistence of the problems derived from the presence of solvent residues in extracts; the use of non-toxic gases (CO₂, freons, butane etc.).
- ✓ *Extraction by pressing:* this method of obtaining the volatile oils is applied in few cases and only at those plants or parts of plants in which the volatile oil is found in large amounts, accumulated in secreting glands superficially disposed. Industrially, the procedure is applied for obtaining the volatile oils from citrus fruits (lemons, oranges, bergamot etc.). The volatile oils obtained in this way have superior qualities to the similar ones, obtained by entrainment with water vapors, because are eliminated the factors that cause degradations on them.
- ✓ *Adsorption on an absorbent material:* This technique consists in extraction of odorous from flowers by their absorption on a support with a high adsorption capacity such as active carbon, silica gel and the alumina. The method has some advantages over the extraction on fats or with solvents. Firstly, because the natural raw material does not touch the absorbent, can "survive" throughout the extraction, the biochemical processes to produce odoriferous substances continuing a while, allowing a higher yield than in the other extractive procedures. The industrial application of this method, under the name of dynamic adsorption is practiced in the last decades and is aimed primarily those flowers from which the odoriferous cannot be obtained except by enfleurage, such as the daffodils, hyacinths, lilac etc.
- ✓ *Distillation with water vapors:* is the method used routinely at the volatile oils extraction from most of aromatic plants; is commonly used for the industrial-scale extraction, but also has widespread use at laboratory level. By this method, the water vapors penetrate the vegetative mass subjected to distillation, destroy the oleific glands casing, volatilize the oil and then mixes with it. The mixture of water vapors and oil vapors refrigerant (condensation vessel) where it turns into a liquid, which is nothing but the mixture of water and volatile oil. This mixture reaches the Florentine vessel (separation vessel) which hosts the separation namely the volatile oil being lighter it will splash over the water. Depending on the arrangement mode of the raw material into the boiler, are known the following types of distillation:
 - ≡ Distillation in water: is used for all the volatile oils, which do not decompose at 100° C. The raw material is placed into water in a ratio of 1: 4 (at one part of raw material are put four parts of water by weight);
 - ≡ Distillation in water and water vapors: applies to the volatile oils at which certain components are dissolved in water, reason for which the raw material is disposed over the water. Heating the water into the boiler to transform it in vapors is made either by direct fire, or by blind pipes with steam. The volatile oil will be so extracted by the vapors that are formed.
 - ≡ Distillation with water vapors: is used in the extraction of the most oils. The process consists in the passage of water vapors obtained in certain installations for the production of the steam, in special boilers at relatively high temperatures and pressures, through the vegetative mass (flowers, herb etc.), placed into special baskets.

The distillation with water vapors is the most widespread method and is applied in the most countries producing volatile oils.

The distillation plant components are: the source of steam, the boiler in which is placed the raw material, the refrigerant vessel and the Florentine vessel for the separation of the volatile oil and the flower water.

The source of steam can be an electric generator for the steam production, one boiler working with gas / diesel, wood (pallets) or an electric kettle.

The boiler (tank) for distillation must be made of stainless steel as well as the input and output vapors pipes, as well as the sieve from the inside on which are placed the plants.

The lid must be of the same material, and on the top of it, must be installed an indicator for the indoor temperature display and safety valves which must open when into the vessel is formed overpressure.

The refrigerant vessel and the cooling coil must also be made of stainless steel. The cooling water temperature in the upper side of the vessel, must be maintained at a value between 27-37°C.

The last component of the plant and the perhaps the most important is the essences separator (the Florentine vessel). It is designed to separate the essential oils and the floral water.

The connections between the components of the installation are made only through fittings and pipes of stainless steel and special hoses, resistant to high temperatures and pressures.

In this context, within INMA Bucharest, Testing Department - TD, have been conducted a series of experiments in view of obtaining of essential oils, using a distillation plant with steam generator under pressure (Figure 1).



Figure 1 – Distillation plant with pressurized steam generator

The distillation boiler has a capacity of 500 l in which can be introduced up to 40 kg of green plants, but not more than 3/4 of the capacity of the vessel. The first set of experiments was conducted in laboratory conditions, in order to extract oils from dried lavender scrap from the variety of *Lavandula angustifolia*, harvested a year ago. The second set of experiments was conducted in exploitation conditions, in Ocna Mures, at a lavender plantation of the same variety, using plants harvested 1-2 days ago, but also very fresh plants, harvested just before to be used.

The fresh inflorescences lavender harvesting was performed semi mechanized, utilizing a lavender harvesting equipment realized within INMA Bucharest, equipped with a mower with oscillating cutters with curved blades, mounted on a light chassis (Figure 2).



Figure 2 – Lavender harvesting equipment

4. RESULTS

The results of the tests performed at INMA Bucharest and Ocna Mures are presented in Tables 1, 2 and 3.

Table 1. The results of experiments utilizing lavender flower scraps

Determined parameters	Test 1	Test 2
The mass of raw material , [kg]	36	38
Air temperature , [°C]	15	17
The temperature of the steam leaving the generator, [°C]	124	130
The temperature in the boiler steam distillation entry, [°C]	107,5	108,3
The temperature of the steam inside the distillation boiler / , [°C]	105	105
Steam temperature at the entrance of the cooling vessel / , [°C]	88.5	89
Cooling water temperature, [°C]	11	11
Duration of test ,[min]	85	75
The volume of volatile oil , [l]	0.085	0.090
Floral water volume obtained, [l]	28	26

Table 2. The results of experiments using lavender flower harvested of 2 days

Determined parameters	Test 1	Test 2
The mass of raw material, [kg]	32	35
Air temperature, [°C]	29	29
The temperature of the steam leaving the generator, [°C]	130	131
The temperature in the boiler steam distillation entry, [°C]	107	108
The temperature of the steam inside the distillation boiler, [°C]	105	105
Steam temperature at the entrance of the cooling vessel, [°C]	90	91
Cooling water temperature, [°C]	19	20
Duration of test, [min]	65	60
The volume of volatile oil, [l]	0.18	0.20
Floral water volume obtained, [l]	23	22

Table 3. The results of experiments using lavender flower just harvested (10-15 min)

Determined parameters	Test 1	Test 2	Test 3
The mass of raw material, [kg]	32	35	40
Air temperature, [°C]	30	30	31
The temperature of the steam leaving the generator, [°C]	131	130	130
The temperature in the boiler steam distillation entry, [°C]	107	107,5	108
The temperature of the steam inside the distillation boiler, [°C]	105	105	105
Steam temperature at the entrance of the cooling vessel, [°C]	91	91,5	91,5
Cooling water temperature, [°C]	20	20	21
Duration of test, [min]	55	65	75
The volume of volatile oil, [l]	0.22	0.26	0.31
Floral water volume obtained, [l]	20	22	27

5. CONCLUSIONS

Lavender occupies a prominent place amongst the plants whose chemical composition can generate a significant amount of essential oils and flower water, the capitalization of these products representing an important source of income for farmers.

For the lavender grown in Romania is extremely important the knowledge of the culture technology in order to obtain a high quality raw material, under the conditions of increasing of the requirement on the market of the products in the field.

In the category of methods for obtaining volatile oils, the distillation with water vapors is the most widespread method and is applied in most countries with tradition in this area.

Following the experiments undertaken, was found that as a main condition for more efficient recovery of the culture of lavender and obtaining as significant quantities of essential oil is to process the lavender flower as quickly after harvesting. It is also necessary the use of modern technologies for the rapid harvesting and processing of the lavender plants.

Note: This paper is based on the paper presented at ISB-INMA TEH' 2015 International Symposium (Agricultural and Mechanical Engineering), organized by „Politehnica” University of Bucharest - Faculty of Biotechnical Systems Engineering, National Institute of Research-Development for Machines and Installations Designed to Agriculture and Food Industry - INMA Bucharest, EurAgEng - European Society of Agricultural Engineers and Romanian Society of Agricultural Engineers - SIMAR, in Bucharest, ROMANIA, between 29 - 31 October, 2015.

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