Scientific Papers. Series B, Horticulture. Vol. LXVIII, No. 1, 2024
Print ISSN 2285-5653, CD-ROM ISSN 2285-5661, Online ISSN 2286-1580, ISSN-L 2285-5653

CURRENT STATE OF RESEARCH ON BIOLOGICAL, ORNAMENTAL AND UTILITARIAN PARTICULARITIES OF SOME SPECIES OF THE GENUS *SALVIA* L. (LAMIACEAE)

Claudia BURLĂCIOIU, Sorina PETRA, Florin TOMA

University of Agronomic Sciences and Veterinary Medicine of Bucharest,
Faculty of Horticulture, 59 Mărăști Blvd, District 1, Bucharest, Romania

Corresponding author email: anghelclaudia@gmail.com

Abstract

This paper is a synthesis of research on the history and current state of knowledge regarding the biological, ornamental and utilitarian characteristics of some species of the genus Salvia L. (Lamiaceae). The analysis aimed to identify the literature from the Romanian and international academic literature, in which the genus Salvia L. (Lamiaceae) is treated, paying particular attention to the species Salvia officinalis, Salvia nemorosa, Salvia splendens, Salvia mellifera. During the activity carried out, historical milestones were determined and highlighted from the perspective of the scientific treatment of the genus Salvia, and a deeper dive into the already existing knowledge has been attempted, focusing on analyzing and capitalizing on the identified specialized works in which the biological, utilitarian and ornamental peculiarities are addressed. The results of the research highlight the importance of the species studied, as they may have an important practical use, both for lovers of sage flowers, as a garden plant, and for researchers and professional growers, as a medicinal and/or honey plant.

Key words: *biological, decorative, medicinal, melliferous.*

INTRODUCTION

The name of the plant upon which this tesys is centred on establishing its main peculiarities (biological, ornamental and utilitarian), *Salvia*, comes from Latin and represents a derivation of the term "save", a, its meaning is "the one who saves". *Salvia* is known by several names, the most relevant of which are salvia, salvir, chalet and lament.

Thus, is easy to assume the fact that it has had an important presence and use in the medical field, since antiquity. The importance of sage was not limited to the medicinal area, it was also used in the food field or as an ornamental and melliferous plant.

During the activity carried out, historical milestones were determined and highlighted from the perspective of the scientific treatment of the genus Salvia, , and a deeper dive into the already existing knowledge has been attempted, focusing on analyzing and capitalizing on the identified specialized works in which the biological, utilitarian and ornamental peculiarities are addressed.

HISTORIC

From a historical perspective, a first scientific approach to the genre was made by English botanist George Bentham, in *Labiatarum Genera et Species: or, a description of the genera and species of plants of the order labiatae* (1832-1836).

Regarding Sage, in the antereferred paper it is noted that, „of this numerous genus, some representatives can be found in almost all the world, but several of its sections are specific to different parts. Thus, *Eusphace*, *Horminum*, *Æthiopis* and *Hemisphace*, belong to the Mediterranean region; some few only of the Drymosphaces and Æthiopiders extending to the eastward as far as the mountains of Cashmere and the Himalaya. The Plethiosphaces are mainly European, Nort Asiatic, and Nort African; two or three species are extending also down the coast as far as the Cape of Good Hope. The Hymenosphaces are about equally divided between the Mediterranean region and the Cape of Good Hope, one scpecies belonging exclusively to the Canary Islands.

Notiophace contains an South Asiatic and Australian one and one North African species, and Gymnosphace an Indian one. Microsphace, Calosphace, Echinosphace, and Pycnosphace are exclusively American - the two latter confined to California; and Heterosphace, although a very natural section, is to be met with in the Mediterranean region, at the Cape, in Japan, and in Nort Africa" (Bentham, 1832).
Salvia officinalis L., has been known since the time of the Greeks and Romans, being mentioned in the writings of Dioscorides and Galen (Barbu et al., 2006).
Later, *Salvia officinalis* is described in 1753 by Carl Linnaeus as being used in the food field and also for healing, being mentioned in several texts for its medicinal properties. It was also considered an immortal substance and mentioned in the works of Greek and Roman doctors as a herb with healing qualities. Hippocrates called sage "sacred plant" and in ancient texts there were sayings like "How men can can grow old who has sage in his garden" (Devansh, 2012).

THE CURRENT STATE OF KNOWLEDGE OF SAGE

Sage, part of the Lamiaceae family, comprises about 500 species.
In this family there are aromatic, herbaceous plants, rarely woody in the form of shrubs and sub-shrubs, with stalks and opposite leaves, simple unstriped. The flowers are zygomorphic, hermaphrodite, clustered in dihazial cimes reunited in vertices. The calyx is gamosepal, in many situations bilabiate; it has the gamopetal corola, bilabiate, androceum didinam, bicarpal gynaeceum, upper-position gamocarpal and tetrachene-type mericarpic fruits (Ciocârlan, 2009).
The scientific clasification of sage is presented in Table 1:

Table 1. Sage systematics

Kingdom	Plantae
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Lamiales
Family	Lamiaceae
Genus	*Salvia*
Species	*officinalis, nemorosa, splendens, mellifera* (…)

In Romania, the presence of several species has been identified, among which we mention:
- species of culture (*Salvia officinalis*, *Salvia splendens* and *Salvia sclarea* L. – Serlai, last present also in spontaneous flora);
- spontaneous species (*Salvia. glutiesa* L., Cincest – shady places, forests, *Salvia. pratensis* L., field sage, *Salvia nemorosa* L., *S. nutans* L., *Salvia austriaca Jacq*, *S. verticillata* L., ear of the pig, all the latter from open places);
- endemic species in Romania - *Salvia transilvanica* Schur (Barbu et al., 2006).
According to Sin et al. (2001), wailing (sage) is among the species that are cultivated for herbs, leaves, flowers, inflorescences, roots and rhizomes (Sin et al. 2001).

Biological features
Barbu et al., 2006 in *Preliminary studies on the biological culture of sage* (*Salvia officinalis* L.), presenting the peculiarities of the genus *Salvia*, shows that „is a semi-shrub of the Labiatae family, thick, with straight or inclined shoots, covered with a brown to light gray bark.
The root is a lignified and highly branched rhizome, the ramifications penetrating deep.
The semi-lignified stem has 25-80 cm high branches, almost round, covered with a felt layer of gold-colored hairs – whitish. The opposite arranged leaves have a 1-5 cm long petiole, oval to elliptical or lanceolate shape. The color varies from white to gray for young plants, to green to gray for the mature ones. It presents a fine pubescence with multicellular hairs (1-4). The characteristic glands of Labiatae in most cases consist of 8 secretory cells.
The inflorescence is simple or branched, spiciform, made up of pseudo-verticillate with 3-10 flowers placed at the branch of the last 5-8 pairs of leaves, the green calyx – violaceus, consisting of 2 lips. The corolla is bilabial, double the length of the calyx, with the lower labium trilobate, longer than the upper one and with the middle lobe bent downwards. Androceum has 4 stamens of which 2 anterior are longer and fertile representing true stamens, the other 2 are short, rudimentary.
Fruits are dark tetrachaenium in the persistent calyx, brownish, ovoid, small 2-3 mm (of them only 1-3 reach maturity).
The seeds are round, dark; the average weight of 1,000 seeds is about 7-72 g, and 129 seeds per

gram. Flowering begins in the second year, and the economic duration of a crop is 8-10 years, the semi-shrub growing up to 12-15 years, but with low vigor.
The entire plant emits a strong characteristic smell with a bitter aromatic taste (Barbu et al., 2006).
In the genus *Salvia*, *Salvia officinalis* is a perennial species, 30-70 cm high, showing oval leaves, cordate-hastate-sagitated base, with sharp basal lobes, as well as leaf tips, vertices with 2-6 yellow corolla flowers, sometimes stained with brown (Ciocârlan, 2009).

Ornamental features

Within the species *Salvia officinalis* we identify the form of *albiflora* Schur (white flowers with green calyx), with varieties such as:
- *salicifolia* (wide and short leaves), *icterina* (green leaves stained with yellow), *aurea* (golden leaves), *purple* (intense red leaves), *tricolour* (leaves showing the turning of the colouring from grayish green and white-yellow to intense red), used, having regard to the variety of shapes and the different colouring of the leaves, in the ornamental field, on calcareous, sunny lands, in curbs, on rocky places, in ruins;
- *argentea* (having strong-flavoured leaves) and *spinosa* (high oil content), used predominantly in crops for production (Barbu et al., 2006).
Another species of the ornamental relevant genus is *Salvia nemorosa* (Figure 1), an attractive-looking plant with a wide presence in gardens since the distant past, easy to grow and with many varieties and hybrids, it was described by Carl Linnaeus in 1762 as *nemorosa* ("of the forests") referring to its typical habitat in the grove and forest (Clebsch et al., 2003).

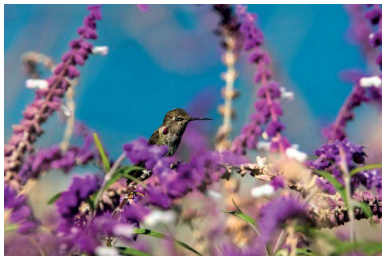

Figure 1. *Salvia nemorosa* (Roberto So)

Also, *Salvia splendens* (Selow - Garden Wales, scarlet sage) (Figure 2), blue-violet, white or yellow, with flowers grouped by (15)20-40 in dense verticals, oval-triangular leaves, with a corded or triangular base and 1-2 pairs of segments at the base, in consideration of its aesthetic qualities, is widely cultivated as an ornamental plant (Ciocârlan, 2009).

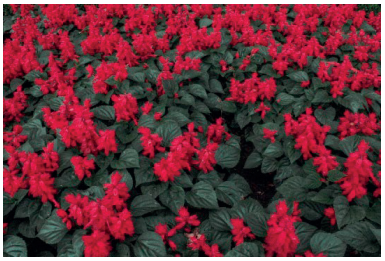

Figure 2. *Salvia splendens* (Murillo Molissani)

Sage splendens, native to Brazil, features a multitude of selected varieties and different colors. It does not survive freezing temperatures, but it can grow in cold climates as an annual plant. The most common selections encountered are dwarf-sized ones ('Sizzler' and 'Salsa'), mass-planted in gardens and malls. 'Van Houttei' reaches the height of 1 to 1.3 m (Clebsch et al., 2003).
Recently introduced in the Romanian culture for its ornamental role is *Salvia farinacea*, perennial plant - annual in Romania (Badea, et al., 2008).
Salvia farinacea is native to Nuevo Leon, Mexico United States (Texas and Oklahoma) with spectacular purple-blue peaks (Turner, 2008).

Utility features

The economic importance of sage, as we deduct from its very name, is not limited to its use only in relation to its aesthetic qualities.
In this regard, we consider, first of all, its usefulness as a medicinal plant, as well as, why not, as a melliferous plant or which is used in the food field.
"Sage (*Salvia officinalis*) has been conventionally used for the treatment of various illnesses since ancient times in various parts of the world. The immense usage of sage, including in the culinary, medicinal, aromatic and pharmaceutical fields makes it the most popular among essential oil-bearing plants. With an increasing demand over good quality organically grown sage, there is a need for further research to standardize the organic cultivation techniques including seed priming to economically viable extraction and processing

methods. The quality of the herb and essential oil content is highly variable depending on environmental conditions and harvesting time. Findings from in-vitro and several clinical studies establish the evidence of its medicinal uses such as cognitive, anti-diabetic, hypo lipidemic, anti-cancer and anti-inflammatory properties. Though it is a very potential and commonly available herb for pharmaceutical industries, there is a need to develop extraction and isolation protocols for testing the efficacy of the herb. The various biologically active compounds in sage are responsible for its pharmacological properties and the extent of cytotoxicity are still unknown and hence there is a lot of scope to conduct drug dosage studies in the future." (Yashaswini et al., 2019).

Therefore, a decisive aspect for the utility of sage lies in its chemical constituents. In Table 2 and Table 3 we present, on the one hand, the chemical constituents of *Salvia officinalis*, as well as the concentration of polyphenols and phenols in hydroalcoholic extracts expressed in µg/g.

Table 2. Chemical constituents of S. *officinalis* (Mehta Devansh, 2012)

Moisture	5.7%
Total Ash	7.7%
Sodium	0.01%
Vitamin B2	0.34mg/100 g
Protein	10.2%
Calcium	1.8%
Potassium	1.0%
Vitamin C	39.8mg/100 g
Fiber	16%
Phosphorous	0.09%
Vitaim A	2395 I.U./100 g
Niacin	5.7mg/100 g
Carbohydrates	46.3%
Iron	0.03%
Vitamin B1	0.75mg/100 g
Caloric value	415 calories/100 g

Table 3. The concentration of polyphenols and phenols in hydroalcoholic extracts of *Salvia officinalis* expressed in µg/g (Neagu et al., 2014)

Gallic acid	0.85
Chlorogenic acid	0.50
Caffeic acid	1.91
Rutin	1.30
Coumaric acid	4.50
Ferrulic acid	1.21
Rosmarinic acid	17.25
Myricetin	1.45
Quercetin	2.80

The usefulness of sage as a medicinal plant

As we mentioned before, Sage has had an important presence and use in the medical field since antiquity (Figure 3).

Figure 3. Sage has been used in medicine since antiquity (Huibre Venter)

Currently, it is recognized the possibility of using sage from a medicinal perspective, on the following levels:

- alternative and complementary medicine for primary dysmenorrhea, the essential oils of *Salvia officinalis* (linalyl acetate, linalool, eucalyptol and (Caryophyllene) being responsible for analgesic activity;
- antibacterial properties on gram-negative and gram-positive bacteria, the synergistic antibacterial activity of extracts of *Salvia officinalis* and *Cichorium intybus* being compared with antibiotics such as amoxicillin and chloramphenicol;
- anti-inflammatory activity, salvia-specific diterpenes acting as a potent anti-inflammatory phytoconstituent;
- anti-nociceptive activity, carnosol (10 mg/kg) and ursolic acid/oleanolic acid (30 mg/kg) inhibiting the inflammatory phase of the formol, nociception and cinnamaldehyde-induced mechanical allodynia;
- cancer therapy, being investigated free radical scavenging properties in plant extracts from *Salvia officinalis*;
- the antidiabetic potential. Investigating the antidiabetic potential of tuyona, a major constituent of the *Salvia* species, it was found to correct the lipid profile (cholestrol and triglycerides) in diabetic rats;
- antioxidant potential;
- Alzheimer's disease, following the research carried out by finding that *Salvia officinalis* is effective in treating the condition of the disease;

- improvement of dementia, specific phytoconstituents reducing, depending on the dose, the pathological conditions leading to dementia;
- antimicrobial and antifungal activity, being studied the inhibitory effect of essential oils from sage leaves (*Salvia officinalis* L.). It was found effective inhibition of *S. aureus, E. coli, Salmonella;*
- viral pharyngitis, as a result of the studies carried out, the effectiveness of plant extracts from *Salvia officinalis* L. in viral pharyngitis, 15% sage spray% providing a convenient and safe treatment for patients with acute pharyngitis;
- management of gum and periodontal diseases, extracts of *Salvia officinalis* L. significantly improving the gingival index and score of the plaque index. Devansh, 2012; Yashaswini et al., 2019).

The usefulness of sage as a melliferous plant

Salvia mellifera (California black sage) produces a nectar from which black sage honey is made, a rare honey, very spiced, which can be created only under certain specific conditions (Figure 4).

On the importance of the usefulness of sage in the medical field are also of interest the records of Romero (1954) on the use of American black sage (*Salvia mellifera*) for healing long-term deep dry cough, which has settled in the bronchial tubes (Romero, 1954).

Figure 4. Sage, melliferous plant (Janice Carriger)

There are also studies highlighting the usefulness of black sage (*Salvia mellifera*) to relieve chronic pain. In this respect it is relevant that black sage, which contains 54 monoterpenoids and several diterpenoids, such as carnosolul (41%), acidul carnosic (22%), salvicanolul (15%) și rosmanolul (9%) [3,4]. Monoterpenoids are 1,8-cineole (39,8%), camphor (12,2%), α-pinene (9,2%), limonene (2,2%), myrcene (2%), γ-terpinene (2%), terpene-4-ol (2%) and many less abundant monoterpenoids, it is considered the traditional medicine of the Chumash Indians of California (Adams et al., 2019).

The usefulness of sage as an edible plant

Sage appears mentioned by *Le Viandier de Taillevent* in the fourteenth century, in a culinary recipe that bears his name – *Cold sage sauce* (Prescott, 1948).

Also, as we have shown in the History section, *Salvia officinalis* is described in 1753 by Carl Linnaeus as being used in the food field (Devansh, 2012).

Currently, Chia seeds (*Salvia hispanica* L.) are increasingly being used by food processors and consumers, with a predominance for food fortification. In this context, in studies conducted to determine the mineral composition of chia seeds, it was found that they contain, depending on the planting season and the region in which they are grown, phosphorus (531 to 889 mg/100g), calcium (478 to 589 mg/100 g), potassium (343 to 526 mg/100 g) and magnesium (322 to 440 mg/100 g), which highlight them as relevant in fortifying food (Figure 5) (Pauline et al., 2023).

Figure 5. Chia - *Salvia hispanica* (Charlotte May)

Sage, naural psychedelic

Salvia divinorum it is a natural psychedelic considered one of the most powerful hallucinogens discovered to date. Few behavioral studies have concluded that the effects of sage may be similar to those of traditional psychedelics, which is noteworthy because sage acts through a unique molecular

mechanism as an agonist of the kappa opioid receptors. One hundred and ninety-three participants, including 34 users of sage, were asked to complete a series of questionnaires related to the general drug use, personality characteristics, and, demographics and their experiences with sage. Sage users were found to differ from non-users in terms of personality characteristics and reported consuming significantly more alcohol than non-users. In addition, although users of sage rated their hallucinogenic experiences as similar to those seen in previously published reports, most have compared their experiences to being more marijuana-like instead of more traditional psychedelics. The low scores at the ARCI LSD sub-scale confirmed this finding and call into question the reigning theory of LSD-like subjective effects caused by Salvia. (Albertson et al., 2009).

CONCLUSIONS

Sage has multiple uses, most in the field of medicine, but also, not at all negligible, in ornamental, culinary and melliferous field.

Given the social impact, as well as the extended economic value, in the field of medicine, this utility of sage has been the subject of several specialized analyzes, fact also revealed in the research identified and highlighted in this paper. However, it is also not to be neglected the other areas where sage can be exploited from an economic perspective.

We consider, in particular, the usefulness of sage as an ornamental plant, which stems from its important aesthetic characteristics (it is a decorative plant both through leaves and flowers, which have a special and intense color and long flowering duration during the year). These characteristics, if more highlighted and presented to interested subjects, could lead to a more important use in residential and urban landscaping.

Moreover, sage attracts insects (bees, butterflies, etc.), which are beneficial to ornamental or production gardens.

At the same time, it is drought resistant, being ideal for hot and dry areas, including for gardens where there are no or cannot be implemented irrigation systems.

Also, the simplicity of gardening-specific activities that are required to be carried out for the maintenance of this species makes it the ideal choice for beginner or limited-time gardeners.

In this context, we note the need to expand, on all levels where they can be carried out, the research to emphasize and, at the same time, highlight the usefulness of sage in the ornamental field.

REFERENCES

Adams. J. D., Guhr S., and Villaseñor E.(2019, 24 ianuarie), *Salvia mellifera - How Does It Alleviate Chronic Pain?*. Retrieved 07.02.2024 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6473501/;

Altberson D.N. and Grubbs L.E., *Subjective effects of Salvia divinorum: LSD- or marijuana-like Journal of Psychoactive Drugs*, Volume 41, pp. 213–217, 2009;

Badea M.L., Pădure I.O., Burzo I., *Cercetări morfologice, anatomice şi fitochimice privind organele vegetative la specia ornamentală Salvia farinacea* Benth. (Lamiaceae), Analele ştiinţifice ale Universităţii "Al. I. Cuza" Iaşi Tomul LIV, fasc. 1, supl., s. II a. Biologie vegetală, 2008, pp. 118-122;

Barbu I., Ambăruș S., Brezeanu C., Stan N., 2006. *Studii preliminare privind cultura biologică a salviei (Salvia officinalis L.).* SC Farmacia Naturii SRL Bacău, 2006;

Ciocârlan V., 2009. *Flora ilustrată a României – Pteridophyta et Spermatophyta.* Edit. Ceres București, pp. 640, 656-680, 2009.

Charlotte May, retrieved 12.02.2024 from https://www.pexels.com/photo/glass-of-tasty-pudding-with-chia-seeds-5947029/.

Clebsch Betsy, Barner, Carol D. *The New Book of Salvias: Sages for Every Garden*. Timber Press. pp. 208, 278-280. 2003.

George Bentham. *Labiatarum Genera et Species: or, a description of the genera and species of plants of the order labiatae*. James RidgwaY and sons, Piccadily, pp. 190-213 (1832–1836).

Huibre Venter, retrieved 12.02.2024 from https://www.pexels.com/photo/person-grinding-herbs-using-mortar-and-pestle-6321840/.

Janice Carriger, retrieved 12.02.2024 from https://www.pexels.com/photo/a-bee-pollinating-a-blooming-sage-16866696/.

Yashaswini S., Fagan J. And Achaefer J. 2019. *Ethnobotany, phytochemistry, cultivation and medicinal properties of Garden sage (Salvia officinalis L.).* Journal of Pharmacognosy and Phytochemistry 2019.

Mehta Devansh. *Salvia officinalis, Linn: Relevanţa pentru cercetarea modernă*. Inventi Impact: Planta Activa, 2012(4): pp. 203-207, 2012;

Murillo Molissani, retrieved 12.02.2024 from https://www.pexels.com/photo/red-salvia-blooming-on-a-flower-bed-8533615/.

Neagu E. Păun G, Radu GL. *Chemical composition and antioxidant activity of Salvia officinalis oncentrated by ultrafiltration.* Romanian Biotechnological Letters. 2014; 19(2):9203-9211.

Pauline W.I., Mburu M., Njoroge D. Gikonyo N & Benjamin M.M., 2003, *Evaluation of the Mineral Composition of Chia (Salvia hispanica* L.*) Seeds from Selected Areas in Kenya* Journal of Food Research; Vol. 12, No. 3; 2023.

Prescott James, 1948, Translated into English *le Viandier de Taillevent - 14th Century Cookery.* Based on the Vatican Library Manuscript Alfarhaugr Publishing Society Eugene, Oregon MCMLXXXIX. Retrieved 07.02.2024 from http://www.telusplanet.net/public/prescotj/data/viandier/viandier425.html.

Roberto So, Retrieved 12.02.2024 from https://www.pexels.com/photo/hummingbird-sitting-among-blooming-violet-salvia-flowers-18543176/.

Romero, John Bruno. *The Botanical Lore of the California Indians with Side Lights on Historical Incidents in California*. Produced by Stephen Hutcheson and the Online Distributed Proofreading Team at http://www.pgdp.net. EBook-No. 55009,VANTAGE PRESS, INC., NEW YORK, pp. 14, 1954;

Sin G și colab. *Îndrumar pentru cultura plantelor de câmp*. Editura Agris-Redacția Revistelor Agricole, București, p.p. 195, 196. 2001.

Turner Billie L., *Recension of Salvia sect. Farinaceae (Lamiaceae).* Phytologia (August 2008) 90(2) pp. 163-175., 2008.