Proceeding Paper

Patent Analysis of Four *Lamiaceae*-Derived Plants: A Medicinally Active Resource against New Health Challenges [†]

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Abstract: This study aims to analyze the patent documents concerning the uses of medicinally active plants (MAPs) in relation to COVID-19 during the last four years. Hereinafter, we demonstrate that MAPs, such as those in the *Lamiaceae* family, can be a fast, healthy, and efficient recourse for designing new drugs or compositions to face new health challenges such as the COVID-19 pandemic. The patent documents concerning sage (*Salvia*), basil (*Ocimum*), lavender (*Lavandula*), and marjoram (*Origanum*) were searched through different specialized databases by using relevant keywords, and the search was performed on the titles, abstracts, and claims. The state of the art in the field was established by extracting data related to publication dates, patent families, patent classifications, applicants, and jurisdictions from the patent documents. Since the advent of the COVID-19 pandemic, about a hundred patent documents linking the studied plants to the coronavirus have been found. Through our case study, we found that most of the patent applications were filed under international jurisdiction by pharmaceutical companies as applicants. Based on the patent classification, most of the claimed inventions are indeed medicinal preparations characterized by being made with *Lamiaceae* or having antiviral activities. Finally, the relevant patent documents demonstrate a particular interest in the valorization of bioactive compounds derived from *Lamiaceae* to improve human defense mechanisms as well as compositions or methods for treating and preventing a coronavirus infection. However, the *Salvia* genus is the most useful for preventing and/or curing SARS-CoV-2 infection.

Keywords: *Lamiaceae*; COVID-19; SARS-CoV-2; pharmacology; phytotherapy; invention; patent analysis

1. Introduction

The end of 2019 saw the outbreak of COVID-19, which quickly turned into a global pandemic. Faced with the urgency of the health situation, some populations have turned to the use of plants recognized as possibly effective against viruses. The scientific community has also been interested in herbal medicine as an effective and healthy source to try to develop drug compositions against SARS-CoV-2.

Medicinally active plants (MAPs) have been utilized as medicine since antiquity. Research in this area has allowed for the accumulation of important knowledge about plant compositions and their therapeutic properties through ethnobotanical and chemical characterization [1]. Among a variety of MAPs, the *Lamiaceae* family are frequently used in therapeutic applications due to the secondary metabolites. *Lamiaceae* includes a large number of species, some of which have interesting antiviral potential [2].

In this study, we focused on the analysis of patents relating to the species of four genera (*Salvia*, *Ocimum*, *Lavandula*, and *Origanum*) of *Lamiaceae* in the context of the fight against COVID-19. The choice of these four plant genera as a study subject was based on

their antiviral activity previously documented in several papers [3–7]. Our choice has been confirmed by the citation of the selected plants in recent scientific research documents as having a specific useful action in the fight against COVID-19. Thus, species of the genus *Salvia* were also used as antivirals during this pandemic due to the antiviral components they contain [8]. Furthermore, the genus *Ocimum* was identified as having potential antiviral activity against SARS-CoV-2 [9], and during the pandemic, species of the genera *Lavendula* and *Origanum* were used in France and Morocco as antivirals [10].

2. Background

Since this study concerns only a few plants of the *Lamiaceae* family, we propose hereinafter an overview of these studied plants, namely sage (*Salvia*), basil (*Ocimum*), lavender (*Lavandula*), and marjoram (*Origanum*) (Figure 1).

Salvia officinalis   Ocimum basilicum   Lavandula officinalis   Origanum majorana

Figure 1. Photographs of the studied plants that belong to the *Lamiaceae* family. The species of these genera have been used as examples.

2.1. Salvia Genus

Salvia is a large genus represented by more than 900 species, mainly in the areas of the Mediterranean, Southeast Africa, and Central and South America [11]. *Salvia* species are known for their biological properties in many countries and might potentially provide novel therapeutic agents. Essential oil and dried leaves and flowers have several pharmacological effects, including antimicrobial, antioxidant, anti-cholinesterase, anticancer, anti-inflammatory, choleretic activities, as well as aid in the improvement of cognitive performance and reducing work-related stress, and so on [12]. *Salvia* species are sources of health-promoting phytochemicals that comprise polyphenols, flavonoids, terpenes, and several other constituents [13].

2.2. Ocimum Genus

The genus *Ocimum* has more than 60 to 150 species [14], taking the form of grasses or bushes, the best known of which is the common basil (*Ocimum basilicum*). Many of these species are aromatic and/or medicinal due to different chemical constituents such as flavonoids, phenolic acids, and terpenes [15]. Apart from roots, the whole plant can be used, whether fresh, dried, or in the form of essential oil. Thus, *Ocimum* species are used for therapeutic purposes as anti-inflammatory, antinociceptive, antipyretic, antiulcer, analgesic, anthelmintic, anticarcinogenic, skin permeation enhancer, immunomodulatory, cardio-protective, and antilipidemic agents. Furthermore, these species have antimicrobial, antioxidant, repellent, insecticidal, larvicidal, and nematocidal properties [16].

2.3. Lavandula Genus

Lavender is an evergreen and aromatic medicinal plant whose flowers are often purple and arranged in spikes. Occurring in the Mediterranean area, Europe, North Africa, Southwest Asia, and Southeast India, it has about 39 known species. It is used to treat various diseases, such as wound healing and microbial and viral infections [17]. Lavender mainly exhibits antioxidant, anti-inflammatory, sedative, antidepressant, spasmolytic, anticholinesterase, antifungal, and antibacterial properties [18].

2.4. Origanum Genus

Origanum is an important multipurpose medicinal plant that comprises 42 species and 18 hybrids widely distributed in Eurasia and North Africa [19]. *Origanum* species have been used for thousands of years as a spice and in ethnomedicine to treat kidney, digestive, nervous, and respiratory disorders, spasms, sore throats, diabetes, lean menstruation, hypertension, insomnia, toothache, headache, epilepsy, urinary tract infections, and so on [20]. The species also possess pharmacological potential and display antiproliferative or anticancer, antidiabetic, antihyperlipidemic, anti-obesity, renoprotective, anti-inflammatory, vasoprotective, cardioprotective, antinociceptive, insecticidal, and hepatoprotective properties [21].

3. Resource and Methodology

The patent document analysis was carried out through different specialized databases. The databases and the search service used in this study have been provided by the EPO (i.e., European Patent Office), the USPTO (i.e., United States Patent and Trademark Office), and the WIPO (i.e., World Intellectual Property Organization) [22–24]. Then, relevant combined keywords (e.g., sage (*Salvia*), basil (*Ocimum*), lavender (*Lavandula*), and marjoram (*Origanum*), COVID-19, SARS-CoV-2, etc.) were searched through patent titles, abstracts, and claims.

4. Results and Discussions

### 4.1. Patent Analysis of Different Medicinally Active Plants

In total, 97 patent documents were published between 2019 and 2022. They concern, in particular, 92 patent applications and five granted patents. The publication of these patent documents is distributed as 47, 20, 18, and 12 for sage (*Salvia*), basil (*Ocimum*), lavender (*Lavandula*), and marjoram (*Origanum*), respectively. To establish the state of the art in the field by determining what has been invented and patented in relation to *Lamiaceae* species from four genera, the found patent documents have been used for extracting data. These data are specifically related to publication dates, patent families, patent classifications, applicants, and jurisdictions.

Figure 2 depicts the publication dates of patent documents related to *Lamiaceae* species from four genera in the context of the COVID-19 fight. Although the initial cases of COVID-19 were detected in China in 2019, no patent document was found that year [25], indicating that the research-based inventions concerning the use of these plants against SARS-CoV-2 were not patented or published in 2019. In 2020, seven patent documents have been published, including six patent applications and one granted patent. Sage was the most popular plant in 2020 with three patent applications, followed by lavender, which had two. One year later, the number of patent documents increased for all plants. For sage, basil, lavender, and marjoram 16, 6, 7, and 3 patent documents were registered, respectively. Finally, last year was the year with the most patent documents. A total of 58 patent documents were published through various patent offices. Sage always stayed in front with 28 patent documents, followed by basil with 13 patent documents. Lavender, on the other hand, had nine registered patent documents, while marjoram had eight.

Figure 3 summarizes the analysis of the discovered patent documents. It details the number of documents by type as well as various data concerning patent families and patent classifications, applicants, and patent filing jurisdictions.

A simple patent family is formed when the same invention is filed in multiple intellectual property offices covering different geographical areas, whereas extended families consist of patent documents relating to the same technology with a common link at the level of the right of priority [26–28]. In our case, *Salvia* shows the highest number of single and extended families (40 and 36, respectively), followed by *Ocimum* and *Lavandula*, both with 16 simple families and a similar number of extended families, and then *Origanum*, which has seven families of each of the two types. This result shows the great potential that

the applicants find for their inventions which they try to protect in a wide geographical area and which give rise to several inventive applications.
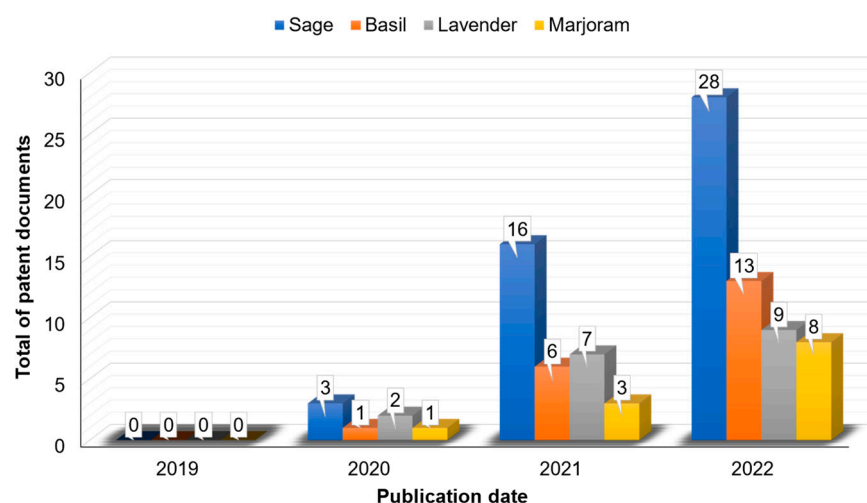
Figure 2. Publication date of patent documents related to the species of four genera in the context of the fight against COVID-19.
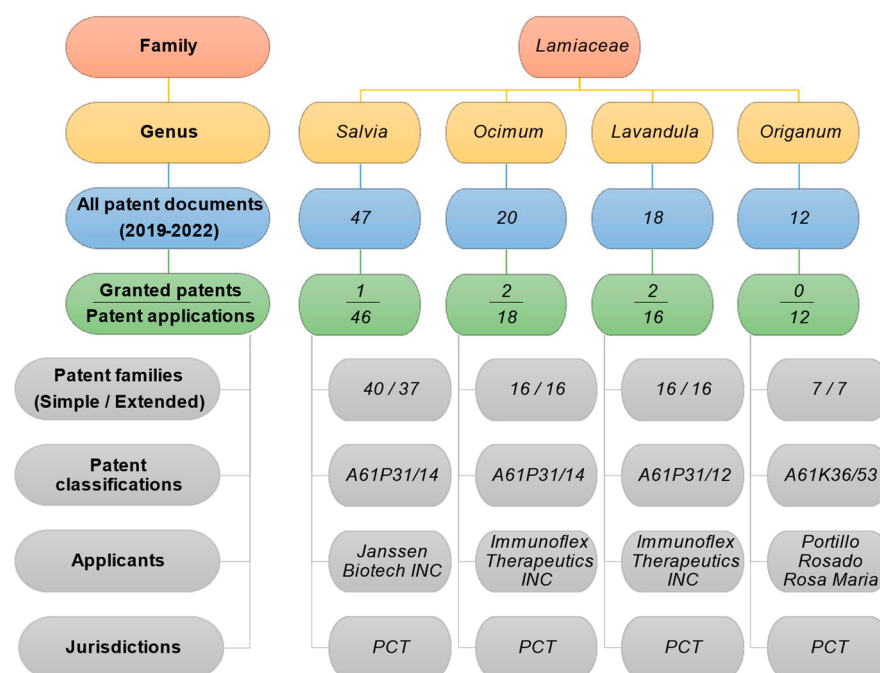
Figure 3. Summary of extracted data from patent documents concerning the species of four genera of *Lamiaceae* and COVID-19.

The International Patent Classification (IPC) is based on the assignment of universal codes to patents based on the characterization of the invention presented. Each code is articulated into a section, class, subclass, group, and subgroup [29–31]. Based on the studied patent documents in our case, we retain the three most common codes that describe the most inventions in the field, linking selected plants with COVID-19 (Table 1). According to these results, we observe that the use of the selected *Lamiaceae* mainly targets the development of therapeutic compositions against viral infections and particularly against RNA retroviruses, as is the case with SARS-CoV-2 responsible for COVID-19.

An applicant is a legal entity and/or one or more natural persons who file the patent application with an intellectual property office [32–34]. Regarding patent documents re-

lated to *Salvia*, the top applicant is the American company "Janssen Biotech INC" (Horsham Township, Pennsylvania, PA, USA), which is active in pharmaceutical development. It is part of the Johnson & Johnson Group, which was able to develop one of the authorized COVID-19 vaccines. For *Ocimum* and *Lavandula*, the company "Immunoflex Therapeutics INC" (Vancouver, BC, Canada), a biochemical and pharmaceutical development company, is the most prolific applicant. For *Origanum*, the inventor and applicant Portillo Rosado Rosa Maria, an example of a natural person as an applicant, recoded three patent documents. Furthermore, the company "Novel Concepts Medical LTD" (Tel Aviv, Israel), a pharmaceutical research and development company founded in 2020 in response to the COVID-19 pandemic, is also a top depositor using *Origanum*.

Table 1. Description of IPC codes (Top 1) of patent documents concerning the species of four genera of *Lamiaceae* and COVID-19.

IPC Code	Description
A61P31/14	Anti-infective agents for the treatment of RNA viruses.
A61P31/12	Anti-infective agents have aimed antiviral effects.
A61k36/53	Medicinal preparations containing material from *Lamiaceae*.

Our results show that patent applicants have, for the largest number of patent documents, chosen to apply according to the Patent Cooperation Treaty (PCT) [35–37]. Accordingly, for *Salvia*, *Ocimum*, *Lavandula*, and *Origanum*, 25, 13, 10, and 5 patent documents were filed under the PCT. The PCT is a global system managed by the WIPO that allows the patentability of inventions to be considered in many countries following a single application. The choice of the PCT shows the confidence of applicants in the economic potential of their inventions, especially since they relate to therapeutic solutions in relation to a global pandemic. In addition, the United States ranked second among patent-filing jurisdictions for all plants studied.

4.2. Relevant Patents of Using Different Medicinally Active Plants against SARS-CoV-2

Hereinafter, we present the relevant patent in the area of the *Lamiaceae*-derived plants use against SARS-CoV-2 in the context of the COVID-19 fight.

To help the immune system reduce excess oxidation during respiratory disease, viable probiotics can keep the antioxidant level high in the blood when administered orally. In 2020, Reddy proposed a multi-phase treatment for coronavirus respiratory infections. Through his invention, Reddy described and claimed a method of treating SARS-CoV-2 coronavirus infection by administering to a human subject in need thereof an effective amount of preparation of a combination of viable probiotics and an herbal extract from clove, turmeric, and basil that is a stimulant of said viable probiotics [38].

To provide a method of preventing or treating some Coronavirus symptoms such as fever, chills, coughing, shortness of breath, difficulty breathing, muscle aches, body aches, vomiting, and diarrhea, Alkalay filed a patent application in 2021 based on different plant components. The patent description cites *Origanum syriacum* as a candidate plant to develop the invention. The used component may be selected from the group consisting of a plant part, extracts thereof, fractions thereof, an active ingredient thereof, a synthetic analog, a mimetic, or a combination thereof [39].

To reduce the viral load in cases of virus infection, especially in the lungs and the gastrointestinal tract, a patent application filed by Crawford in 2021 described and claimed compositions and methods for a nasal spray or mouthwash formulation. The formulation includes an algae derivative and a buffer. The method effectively bathes the mouth and throat tissues to decrease SARS-CoV-2 concentration and functionality. The formulation comprises at least one essential oil from some plants, among which are oregano oil and lavender oil [40].

Based on the Chinese pharmacopeia, Wu and Shi filed a patent application in 2021 for making a drug capable of inhibiting the COVID-19 virus due to a composition of Chinese

medical herbs. Among the used herbs is *Salvia miltiorrhiza*. This is a specie of *Salvia*, also known as red or Chinese sage, and it is a perennial plant highly valued for its roots in traditional Asian medicine. The method includes extracting the Chinese medical herbs with an organic solvent to produce an extract and removing the organic solvent from the extract to obtain the desired composition [41].

5. Conclusions

The establishment of the patent system encourages economic development and technology transfer while protecting creativity. Our study takes advantage of the analysis of patent documents to highlight the potential of certain MAPs to respond to new health challenges such as the COVID-19 pandemic. It has been demonstrated in the case of the fight against this pandemic that the genus *Salvia* was the most patentable among the four plants studied, with 47 patent documents found, which constitute the most simple and extended patent families (respectively, 40 and 37). However, only one patent application, relating to the genus *Salvia*, has been able to result in a granted patent, while patentability relating to the genera *Ocimum* and *Lavandula* has allowed the grant of three patents, one of which cites the two genera of plant in the development of the claimed invention. Finally, with 16 patent applications and no patents granted between 2019 and the end of 2022, the species of the genus *Origanum* are the least cited in the fight against COVID-19 among the flats we studied.

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