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Insecticide Activities of the Essential Oil of Lavandula Stoechas from the Region of Doukkala and Roummani (Morocco)

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Abstract

Medicinal aromatic plants are widely used in several fields, such as cosmetics, pharmaceuticals and the food industry. In this context, our work has been devoted to the chemical study of the medicinal plant "Lavandula Soekès" which is widely used by Moroccan women. The plant studied was collected from two regions of Morocco, the region of Roummani, province of Khemisset, and the region of Doukkala. In order to have new bio insecticides, we extracted the essential oils using the method of hydrodistillation of Lavandula Soekès harvested from two different Moroccan regions. The essential oil yield is RHE=2.58% and RHE=3.42% for the Roummani region and the Doukkala region, respectively. Spectral analyzes by CPG and CPG-MS have shown that essential oils are rich in L-Fenchone. The insecticidal activity of the essential oil of Lavandula showed an insecticidal property against the two insect pests used.

Keywords: Medicinal aromatic plants, Lavandula Soekès, Insecticidal activity

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1. Introduction

For decades, humans have used plants with an immense reservoir of potential compounds attributed to secondary metabolites and which possess a range of biological activities [1], these plants have been used to treat and cure all kinds of diseases. However, the evaluation of biological activities is the interest of many studies [2]. Lately, aromatic plants have a considerable advantage thanks to their progressive applications in the medicinal fields and in the food industry [3]. With the revolution in the agro-food field, humanity must maximize its food production, to do this, it must reduce the abundance of animal species that are in food competition with the human being [4]. Among these animals, we find the invertebrates of which the insects represent the most diversified group and the richest in number of species [5]. According to the Food and Agriculture Organization of the United Nations (FAO), losses due to insect pests correspond to 35% of global agricultural production [6]. Insect pests of stored foodstuffs can cause significant losses by reducing the quality and/or quantity of stored products. Therefore, it is more useful and more profitable to ensure good conservation of crops than to compensate for losses by

increasing production [7]. Nowadays, chemical insecticides are the most widely used technique to control insect pests, due to their effectiveness and easy application [8]. However, the intensive use of these insecticides has caused contamination of the biosphere and the food chain, an eradication of non-target species such as auxiliary fauna and also the appearance of resistant insects [9]. So, this framework, it is necessary to continue the search for new molecules taking into consideration criteria other than efficiency. This research was oriented towards biological control using active, non-polluting natural substances of plant origin [10]. All of the services provided by plant biodiversity, particularly in the regeneration of ecosystems, make it an essential element for humanity [11]. This is particularly true for medicinal plants which, as an important part of this biodiversity, are widely used by humans in addition to constituting a cultural and natural wealth specific to each of the communities and the territories they occupy [12]. In the Mediterranean basin, there are a large number of aromatic plants [13]. Its climate rich in luminosity and heat, accompanied by marked seasons, requires plants to make adaptive efforts favorable to an evolutionary molecular richness giving them multiple properties, including the insecticidal effect [14].

Species of the family Meliaceae, Rutaceae, Asteraceae, Labiateae and Canellaceae are the most promising main families as a source of bioinsecticides [15]. Among several essential oils, those of the Labiateae family have received considerable attention in the search for natural products to control stored-food pests [16]. The same family has been the subject of several studies and they have shown that aromatic species are the most used to control insects [17]. Depending on available resources and phytophagous pressure, plant families develop different amounts of their resources to protect them [18]. However, many of them have not yet been studied both in terms of phytochemicals and insecticidal properties [19]. This work aims to develop insecticides of plant origin, and the identification of some aromatic medicinal plants widely used by Moroccan women. The plant used in our study is Lavandula. The choice of this plant is due to the presence of secondary metabolism molecules belonging to very diverse chemical families such as alkaloids, phenols, flavonoids, trapenoids, steroids.

2. Materials and Methods

2.1. Materials

Lavender belongs to the labiatae family which groups aromatic plants such as thyme, savory, rosemary, oregano, mint, sage. The plant is a shrub, with linear leaves and small terminal inflorescences, the highly fragrant flowers. The plant is relatively hardy, able to withstand winter storms. It grows profusely after the rain falls.

2.2. Extraction method

In order to extract the essential oil from Lavendula Stoechas using the hydrodistillation method, the plant is dried at room temperature away from light. A quantity of 100g of the mixture of the vandula staekas put in a flask of 2000mL, is completely immersed in water (proportion of 60%), a few grains of pumice stone are added, everything is then brought to the boil. The heterogeneous vapors are condensed in a cooler and the essential oil separates from the hydrosol by simple difference in density. The essential oil being lighter than water, it floats above the hydrosol.

2.3. Characterization

2.3.1. Qualitative and quantitative analysis of the essential oil of vandula stoekas

In our study, the qualitative and quantitative analysis of essential oils was made by the following two methods: gas chromatography (GC) and gas chromatography coupled with mass spectrometry (GC-MS) for the two plants. The chromatogram was coupled to a computer equipped with IQ3 software to calculate the percentages of the different constituents of the essential oil.

2.3.2. Insecticidal activities of the essential oil of lavandula stoechas

The study was focused on two beetles: R. dominica and S. oryzae. These insects were collected at the grain souk in Salé. The equipment used consists of petri dishes 9 cm in diameter with a mesh screen in order to obtain perfect aeration of the contents of the boxes, wheat and micro syringes. The experimental protocol used to evaluate the toxic effect of essential oils on these insects is as follows: Three Petri dishes each containing 5 g of wheat on which we deposited a volume of essential oil using micro syringes. 10 adults of each insect species were then placed separately in these petri dishes. The witnesses, 10 in number and under the same conditions, did not undergo any treatment. The tests were conducted under ambient temperature conditions.

3. Results and Discussion

3.1. Yield obtained

The extraction yield of the essential oil of "lavandula stoechas" obtained is calculated as follows:

$$Rendement = (M_{exp} / M_{th}) \times 100.$$

RHE= (Mass of EO / mass of dry plant) x100
RHE=(5.16/ 200) x100
RHE=2.58% for the Rommani region
RHE=3.42% for the Doukkala region

3.2. Qualitative and quantitative analysis of lavender essential oils

In our study, the qualitative and quantitative analysis of essential oils was made by the following two methods: Gas chromatography (GC) for the two plants. And gas chromatography coupled with mass spectrometry (GC-MS) for both plants. Qualitative and quantitative analysis by GC-MS has identified almost more than 20 compounds, which are divided into the following chemical groups: monoterpenes; sesquiterpenes and terpene alcohols. Lavandula Stoechas essential oils are characterized by the majority compounds, namely (Table 1) [20].

3.3. Insecticidal activity of essential oils (EO)

For the two doses of 12 and 50 µl of essential oil, the percentage of mortality of S. oryzae is 100% after 24 hours of treatment, whereas the dose of 3 µl is characterized by a percentage of 75% mortality for the same duration of

treatment and 100% in 52 hours after treatment. For the controls, no death was observed during the 4 days of treatment. (Table 2 and Table 3). There was a 100% mortality of R. Dominica for the doses of 50 and 12 µl of lavandin essential oil from 24 hours after treatment. Regarding the 3 µl dose, mortality was 56% after 24 hours of treatment. The percentage of 100% mortality was only observed after 96 hours. (Table 4, Table 5). According to these results we can conclude that the HE of the essential oil of lavandula Soekes from two different regions of Morocco: The region of doukkala (oulad jerrar) and the region of Zaèr (Roummani) proved to be the most effective, whatever the the concentration used and the species of insect chosen, since the mortality of the insects was total and that in the first 24 hours following the treatment.

According to the results obtained in a previous study on the effect of the essential oil of five medicinal plants: Eucalyptus, Mint, Thyme, Rosemary and Lemongrass, the essential oils were found to be more toxic by inhalation than by contact or ingestion, on two species of stored-food insects: Tribolium confusum and Sitophilus oryzae. Total insect mortality only reached 100% after 6 days post-treatment. The EO of M. suaveolens proved to be toxic for the two species of Coleoptera, the percentage of mortality is 100% respectively for the doses of 50 and 12 µl. For the 3 µl dose, we observed acute toxicity causing approximately 85% mortality on the first day of treatment, whereas it reached 100% on the second day. The insects undergoing the treatment with a dose of 3 µl showed a small resistance which did not last more than a day since total mortality was reached after the second day. The absence of mortality at the control level shows that our test remains reliable for the study of the insecticidal effect of the essential oils tested [21]. The insecticidal activity of the essential oil of these plants does not require much time to manifest; it is almost identical for the three mint species, the maximum mortality (100%) being recorded on the first day after treatment with a dose of 12 µl. All these tests carried out can confirm that the treatment of foodstuffs with essential oil from aromatic and medicinal plants can be very effective in controlling stored food pests. These oils contain chemically very interesting.

4. Conclusions

Natural products were and still remain an inexhaustible source of complex and diverse structures given the role that certain pure compounds can play in many applications, namely the pharmaceutical industry, the food industry, the cosmetics industry, perfumery. Plants synthesize several substances of secondary metabolism, these molecules can have different effects in insects: repellent, attractive, disruptive of development, inhibitor of reproduction. Their toxicity can be direct or indirect on the target organs (sensory organs, nervous system, endocrine system, digestive system, reproductive system, etc.).

This work was carried out within the framework of the valorization of Moroccan Aromatic and Medicinal Plants, we were interested in the study of the insecticidal activity of essential oils extracted from lavandula saekas from two regions which grow spontaneously in Morocco. The yield of essential oil extraction from lavender in two regions by the hydro distillation method is successively: 2.58% (for the Zaire region) and 3.62% (for the Doukkala region). CPG-MS analyzes showed the existence of L-FENCHONE (26.05%) as the main product of the essential oil of lavender from two regions Essential oils have proven to be too toxic to insect pests of stored foodstuffs: S. oryzae and R. dominica with a very high mortality rate. These essential oils can be used as Bio insecticides to minimize the use of synthetic insecticides. At the end of this work, we can conclude that the oils of lavender certainly have an insecticidal activity on the two species of insects: S. oryzae and R. dominica.

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