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Eucalyptus camendulensis and Its Drying Effect on Water and Essential Oil Content

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***Abstract*—**Medicinal and aromatic plants are promising and are characterized by the biosynthesis of odorous molecules that make up the so-called essential oils (EO), which have long been known for their antiseptic and therapeutic activity in folk medicine. Essential oils have many therapeutic properties. In herbal medicine, they are used for their antiseptic properties against infectious diseases of fungal origin, against dermatophytes, those of bacterial origin. The objective of this study was to evaluate the influence of drying in the shade on the water content and on the content of essential oils extracted from leaves of *Eucalyptus camendulensis* for better quality control of medicinal and aromatic plants. The water content of the *Eucalyptus camendulensis* plant material decreases during the drying process. It decreased from 100% to 0.006% for the drying in the shade after ten days. The moisture content is practically constant at the end of the drying period. The drying in the shade increases the concentration of essential oils of *Eucalyptus camendulensis*. When the leaves of *Eucalyptus camendulensis* plant are in the shade, the maximum of the essential oil content was obtained on the eighth day, the recorded value was 1.43% ± 0.01%. Beyond these periods, the content continuously drop in before stabilizing. The optimum drying time is between 6 and 9 days.

Keywords*—Eucalyptus camendulensis*,** drying, essential oils, water and essential oil.

I. Introduction

DUE to its special geographical situation, Algeria has a very wide range of climates promoting the development of a rich and diverse flora. Indeed, the country has great potential medicinal and aromatic plants (MAP) estimated at more than 800 species [1], many of which are endemic. This wealth of Algeria hoisted to the rank of major countries producers and suppliers of herbs and their extracts.

Throughout history, the plant kingdom has provided the essential human resources to its feeding, hygiene and health. Since ancient times, the fragrances of these same plants are associated with mystic rites, artistic and aesthetic.

The MAP are plants that have grown or have picks in his natural environment for its medicinal and had an infinite variety of jobs, to report the therapeutic area, food, cosmetics, industrial, etc.. Herbs can play an important role in conserving biodiversity. These plants are actually very familiar to rural people who are very sensitive to their scarcity and their disappearance. Indeed, medicinal plants play an important role of health care population and represent a significant source of income for many families in the countryside and cities [2].

MAP sector plays a large part and plays a big role in the national economy. Existing activities in this area allow export of around 1,000 tonnes of essential oils and various extracts and approximately 400 tons of dried herbs, with a total value of 300 million dirhams. They also allow the annual creation of some 500 000 working days for local communities [3].

Several works on the PAM drying indicate considerable changes, especially in quantitative terms, the level of essential oils. In this sense, [4] found that the essential oil content of Eucalyptus citriodora dried leaves in the shade for a week was 1.70% against 1.14% for fresh leaves. By studying the effect of storage leaves of another species of Eucalyptus (*E. tereticornis*), [5] reported that the essential oil content varies from 1.32 to 1.54% when the sheets are stored in the shade for a week. This variation was from 1.31 to 1.42% when they are kept in the sun for the same period. The increase in volatile oil content with drying suggests continuity and accelerating the biosynthesis of essential oils after harvest of plant material [6], [7]. However, upon drying, an aromatic plant may lose some of its essential oil and volatilization by entrainment with water vapor removed. These losses are even more important than the drying time is long [8], and that the temperature is too high.

Natural drying is a method of harvesting and conservation free, environmentally friendly, and efficient. In fact, this technique generates neither waste nor emissions. In addition, it improves product quality by avoiding contamination, retain their active ingredients, increase their lifespan, reduce their weight to facilitate transport, and to diversify their use [9], [10].

In order to contribute to the valorisation of the drying process, often uncontrolled and expensive link for producers, we were interested in the evaluation of the effect of the duration and method of this phenomenon on the content and chemical composition of essential oils of Algeria to optimize these two parameters.

II. Materials and Methods

A. Origin and Drying of Plant Material

The adult leaves of *Eucalyptus camendulensis* used in this study were collected in the Ouargla region (southern Algeria) in September 2010 on five trees at random. The leaves of these five trees were brewed to build an "all comers". Two lots of about 15 kg each originating from that all comers were subjected in parallel to the drying in the shade. The shade drying is carried out in the laboratory. The raw material is spread thinly and returned frequently.

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The River Red Gum (*Eucalyptus camaldulensis*) is a tree of the genus *Eucalyptus*. It is one of around 800 in the genus. It is a plantation species in many parts of the world but is native to Australia where it is widespread especially beside inland water courses. Oddly, it is named for a private estate garden near the Camaldoli monastery near Naples (L'Hortus Camaldulensis di Napoli), from where the first specimen came to be described. Material from this tree was used by Frederick Dehnhardt, Chief Gardener at the Botanic Gardens in Naples, to describe this species in 1832 [5].

B. Classification

- **Riegner:** Plantae
- **Sous règne:** Angiosperms
- **Class:** Eudicots
- **Order:** Myrtales
- **Family:** Myrtaceae
- **Genus:** *Eucalyptus*
- **Species:** *Eucaluptus camaldulensis*

The hydrodistillation of *Eucalyptus camendulensis* (leaves dry) is performed using a Clevenger-type device (1928) Fig. 1.

Fig. 1 Installation of hydrodistillation (Clevenger apparatus)

The extraction procedure comes down to boil a quantity of 100 g of dry plant for 2 h with water in a 1 liter flask. The distillation was carried out with a recycling cohobage commonly known as described in the Ph.Eur [11].

C. Determination of Water Content and Essential Oil

To determine the water content (moisture) of each batch, a quantity of fresh leaf mass Mf = 5 g ± 0.01g was dried in a type Memmert oven to 105 ° C for 24 Hours (up 'to a constant weight). The mass of the dried leaf (Ms) was determined using a balance accurate to 0.01 g and the water content is given by:

$$TEau = [Mf - Ms / Mf]x100$$

The extraction of the essential oil was conducted by a daily hydrodistillation of three samples of 100 grams each, from each batch in a Clevenger type apparatus [12]. The distillation lasts three hours after the onset of the first drop of the distillate to the output of the steam condensing tube. The essential oil was stored at 4°C in the dark and dried with anhydrous sodium sulfate. The essential oil content, expressed in ml of the distillate by 100 g of dry matter, is expressed by:

$$T_{HE} = (V / M_S \text{ X } 100) \pm (\Delta V / M_S \text{ X } 100)$$

III. Results and Discussion

A. Drying Effect on the Water Content

This study allowed us to monitor and evaluate the effect of drying time on the water content of leaves of *Eucalyptus camendulensis*. It is presented in Fig. 2.

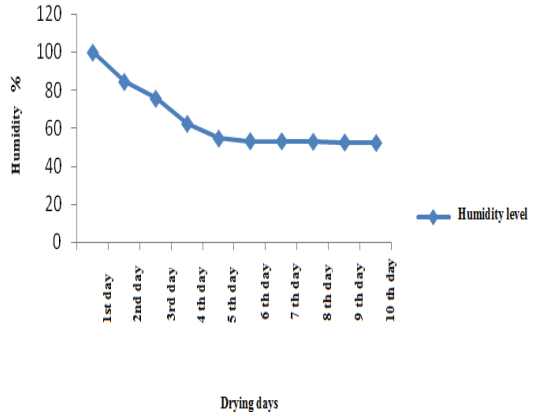

Fig. 2 Evolution of water content of leaves *Eucalyptus camendulensis*

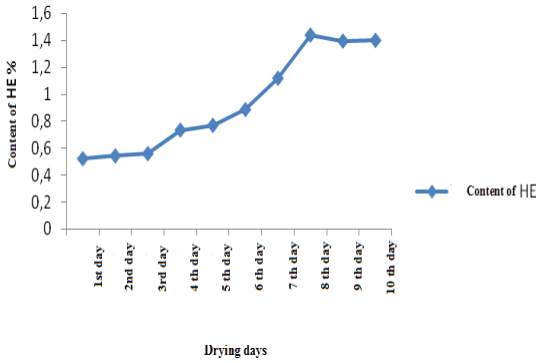

Fig. 3 Evolution of the essential oil content of the leaves *Eucalyptus camendulensis* during drying

During the drying process, the analysis of Fig. 1 shows that, the water content gradually decreases and then becomes almost constant virtually constant at the end of the drying period. Thus, it passes to the drying of 100 to 0.006%. In this graph we recognize two phases:

- Phase I: until the fifth day of the beginning of drying
- Phase II: the fifth day until the tenth day.

The undesirable humidity level for the essential oils concentration is at its maximum, it would be about 10%.

B. Drying Effect on the Essential Oil Content

The results of the evolution of the essential oil content of the leaves of *Eucalyptus camendulensis* during drying are shown in Fig. 3.

Fig. 3 shows the variation of the content of essential oils according to the drying time. The essential oils concentration increases according to the days of drying, then it drops to tend to stabilize at the end of drying. Increasing the content of essential oils during the first days of drying is proportional to the decrease of the humidity.

The maximum of the essential oil content is obtained on the eighth day; the recorded value was 1.43% ± 0.01%. We therefore find that the yield of essential oils varies with the drying time.

The variation of the essential oil content of the leaves of *Eucalyptus camendulensis* before the distillation according to the duration of drying is similar to what has been found for several other aromatic species, such as *Eucalyptus camaldulensis* [6], verbena [13], *Ammi visnaga* [14], and rosemary [15].

Increasing the concentration of essential oils, expressed in dry weight during the first few days of drying is explained by a physiological activity (enzymatic reactions) important.

Biosynthesis of essential oils and continues accelerating after the harvest of the plant material in response to water stress. Its decrease after seven and nine days of drying respectively was due to the reduction or discontinuation of enzyme activity causing cell death due to severe dehydration. For industrial applications, it is therefore necessary to extract the essential oil from the leaves of *Eucalyptus camaldulensis* about a week after harvest, since the essential oil content is at its maximum. Beyond this period, they qualitatively and quantitatively lose their essential oils.

The results concerning the effect of drying on the chemical quality of the essential oils of *Eucalyptus camaldulensis* leaves are comparable with those found for *Eucalyptus camaldulensis* in Morocco. For industrial use, it is therefore appropriate to extract the essential oil from the leaves of *Eucalyptus camaldulensis* about a week after harvest, since the essential oil content is at its maximum. Beyond this period, they lose their quality and quantity of essential oils.

IV. Conclusion

Many herbs contain chemical compounds having antimicrobial properties. Several research studies have focused on essential oils extracted from these herbs.

The search for new therapeutic nature herbs served primarily showed the validity of their use by traditional healers. It also demonstrated that our country has a rich and varied plant biomass. This is an immeasurable source for the development and the development of new active molecules for therapeutic target.

Our study aimed to know better the *Eucalyptus camendulensis* through the study of its aromatic fraction (EO-HA). We have shown that for better industrial use essential oil of this species, it is appropriate to extract the essential oil from the leaves of *Eucalyptus camaldulensis* after a week of drying after harvest, since the content of essential oils would at its maximum. Beyond this period, they qualitatively and quantitatively lose their essential oils. All of these results are only a first step in the search of substance biologically active natural source. Additional tests are required and must be able to confirm the performance highlighted, for it would be interesting also to further phytochemical and biological investigations on these plants including the purification of the extracts obtained in order to isolate the molecules responsible for the different activities, which will expand the therapeutic arsenal of herbal plants.

The use of volatile formulations of aromatic and medicinal plants can have many advantages over existing products syntheses. Substances of vegetable origin are valuable sources of active material. These products of natural origin can play a very important role in control programs in the future.

Economically, this study allowed developing this scent plant and finding new applications in many leading industries such as medicines. The results of this research could have, in the medium term impact on sustainable development.

The study of essential oils is the topic that intrigues research laboratories despite its age where new perspectives are implemented for a sophisticated design of plant biotechnology. Essential oils are used in aromatherapy, pharmacy, perfumery, and cosmetic products [16] due to their wealth of active ingredients that are loaded by a vital energy of natural origin. Also, they are used in biological control as biopesticides due to their inhibitory action on growth and toxinogenesis of several bacteria and fungi.

For this purpose, the crude extracts of the plants begin to have great interest as a potential source of bioactive natural molecules. These constituents are classified into two types of primary and secondary metabolism. Secondary metabolites are produced often complex chemical structures, widely dispersed and very different in different species. This study once again allows the development of the operation of the essential oil in the fields, pharmaceutical and cosmetics and as a preservative in the field of food industry. These preliminary results may be supplemented by other more detailed study (antioxidant is testing, performance testing on other bacterial strains, etc.).

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