



## The Essential Oils-bearing Plant Containing Eugenol in Vietnam

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### Authors' contributions

This work was carried out in collaboration among all authors. Author LHH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author LMXT managed the analyses of the study. Author NQT managed the literature searches. All authors read and approved the final manuscript.

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### ABSTRACT

**Aim and Objectives:** Eugenol is widely used in the pharmaceutical and aromatic industries, so the task of surveying to find essential oils containing eugenol is very important. The purpose of this study is to investigate essential oil-bearing plants containing eugenol in Vietnam for pharmaceutical and aromatic industries.

**Materials and Methods:** By the method of fresh sampling of essential oil plants, essential oils are extracted by steam distillation and then analyzed by high-resolution gas chromatography (HRGC) to identify eugenol sources.

**Results:** We have found that a lot of plants containing high eugenol content mostly grow wild in forests such as *Hiptis suaveolens* Poit. containing 62-67% eugenol, *Cinnamomum verum* Prest: 75-80%, *Camellia sasanqua* Thumb.: 90-95% can be used to exploit essential oils and extract eugenol. We also pointed out that essential oil plants containing high eugenol as *Cestrum nocturnum* L.: 50-55%, *Ocimum sanctum* L.: 60-65%, *Ocimum gratissimum* L.: 65-75% can be cultivated to obtain eugenol for the pharmaceutical and aromatic industry.

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**Conclusions:** During the survey, we discovered and made a list of 10 plants as a source of essential oils containing eugenol in Vietnam. The rainy season in Vietnam is from June to September. During this season, the essential oil content in the fresh leaves is lower than in the dry season, therefore, the eugenol content in the essential oils is low. However, due to the strong-growth of plants in the rainy season, a lot of fresh leaves can be harvested, which mean there are more essential oils presented to be extracted.

**Keywords:** Forest; grow wild; mountains; pharmaceutical industry; tropical country.

## 1. INTRODUCTION

Vietnam is a tropical country with a lot of mountains and forests, which is very suitable for essential oil-bearing plants. The work of surveying and exploiting plants with essential oils that grow in the wild brings high efficiency for the economy, so there are many programs to survey these wild-growing oil plants. Among the plants with essential oils in the forest, there are many essential oils containing eugenol.

Eugenol is an important substance for the pharmaceutical area, there have been many studies on the activity characteristics of eugenol in traditional medicine. It was found that eugenol and its essential oils contained many precious properties such as antiseptic [1,2,3], anti-mildew, anti-inflammatory [4,5], antioxidant properties [6,7,8], against periodontal pathogen gingivitis [9,10]. Eugenol can be combined with zinc oxide to form zinc oxide eugenol that has dental restoration applications, effective for acute pain relief, eugenol-zinc oxide paste is also used to seal the canal [11].

Eugenol is used in both foods and cosmetics as a flavoring agent [12,13]. Eugenol is the raw material to synthesize many more expensive aromatics as vanillin [14], so it is an important ingredient of the aromatherapy and pharmaceutical industry. Eugenol is found in the chemical composition of many essential oils such as *Ocimum Gratissimum L.* [15,16], *Ocimum sanctum Linn* [17], the essential oil of cinnamon leaf [18].

Previous investigations have studied and listed many kinds of essential oils in Vietnam, however, little attention was paid to essential oils with eugenol, as well as the distribution, and natural conditions of essential oils plants containing eugenol. The purpose of this study is to identify plants with essential oil containing high eugenol in Vietnam, which grows wild in the mountainous forests and establish plan to grow these plants on a large scale to get essential oils.

The project of investigating eugenol-containing plants brings many benefits for Vietnam, not only identify plants with eugenol in essential oil but also the growing areas, and its ecological conditions. From the results of the survey, the Government will have follow-up plans to exploit essential oil from these plants that grows wild in the mountainous forest or grow them as a source of essential oil for pharmaceuticals and fragrances.

## 2. MATERIALS AND METHODS

Fresh samples of plants containing essential oil were collected from different regions of Vietnam follow the instructions of Professor Do Tat Loi [19]. Samples of essential oil were collected 4 times during the dry and rainy seasons in March, June, September, and December of the year.

Fresh sample of *Ocimum gratissimum L.* plants collected from Hai Duong, Nghe An, Dong Nai, Tien Giang province to get essential oil. Fresh sample of *Cinnamomum verum Prest* plants collected from Nghe An, Tay Ninh province. *Camellia sasanqua Thumb* and *Ocimum sanctum L plant* collected in Daclak province. Fresh leaf samples of *Hiptis suaveolens Poit* plant harvested in Tan Ky district, Nghe An province.

Method of taking essential oils from fresh samples collected and extracted by distillation.

Sample of 250 g of the fresh leaves or roots were cut into small pieces and immediately extracted by water-distillation using simple Clevenger apparatus for 4 hours. The oily layers obtained were separated and dried over anhydrous sodium sulfate ( $\text{Na}_2\text{SO}_4$ ). The extracted oil was stored as aliquots at 4°C. The yields were calculated on a weight basis of the plant material (v/w %).

Method of determining eugenol content in essential oils by high-resolution gas chromatography (HRGC) and the standard

sample of eugenol. The results were analyzed on a Japanese Shimadzu GC-9A gas chromatograph with 20M PEG column chromatography.

### 3. RESULTS AND DISCUSSION

#### 3.1 The Essential Oils-bearing Plant with Eugenol in Vietnam

##### 3.1.1 *Hiptis suaveolens* Poit.

The scientific name is *Hiptis suaveolens* Poit., the local name is “É lớn tròn”, is the family (Lamiaceae). It has a square body, grows straight, about 30-50 cm tall, *Hiptis suaveolens* Poit. is also a traditional medicine, it is used to treat allergies, rashes, fever, flu. People often use boiling water pot with Marjoram to treat colds very effectively.

In Vietnam *Hiptis suaveolens* Poit. is grown everywhere from the countryside to the high mountains, the plants are easy to grow, prefer humid areas.

##### 3.1.2 *Ocimum sanctum* L

The scientific name is *Ocimum sanctum* L., (*Ocimum tenuiflorum* L.) of the Lamiaceae family has a local name: “Hương nhu tía”. *Ocimum tenuiflorum* is growing wild in many mountainous provinces like Lang Son, Ha Tinh, Quang Binh, Quang Tri, Quang Ngai, Quang Nam, Da Nang, Gia Lai, Kon Tum, Dak Lak. The plants are not picky and easy to cultivate, can be planted in a large area to get essential oil.

##### 3.1.3 *Ocimum gratissimum* L.

The scientific name is *Ocimum gratissimum* L. belongs to the Lamiaceae family, locally known as “Hương nhu trắng” is grown wild in many places as Hà Giang, Quảng Ninh, Dac Lak, Lam Dong province. Nowadays, *Ocimum gratissimum* L. plant is grown in many places such as Hải Duong, Hung Yen, Nghe An, Quang Binh, Dong Nai, Long An, Tien Giang. *Ocimum gratissimum* L. plants are grown on a large scale for essential oils. They are herbal plants 1-2 m high, live many years, easy to grow, not picky. The plant grows wild and thrives in the rainy season, and in the dry season, some barren plants will die.

##### 3.1.4 *Cinnamomum verum* Prest

Scientific name is *Cinnamomum verum* Prest of the Lamiaceae family has a local name: “Quế

quan”, a tree 10-18 m in height can reach 50-60cm in diameter. Trees often branch from near the base to form a dense, hemispherical canopy. The outer bark of young branches is light brown, but on old branches and stems, it is grayish-brown or dark brown. *Cinnamomum verum* Prest is grown wild in many places as Tay Ninh, Thanh Hoa, Nghe An province. *Cinnamomum verum* Prest is a precious medicinal plant in everyday life. People use it to treat many diseases such as flu, edema, enteritis, headache, cold limbs, gastritis, diuretic abdominal pain, and some skin diseases. Some people also cook *Cinnamomum verum* Prest leaves to wash hair for aroma.

We surveyed different parts of plants such as leaves, barks, roots and discovered the main component of the essential oil of leaves are eugenol, of barks and roots are cinnamaldehyde (Table 2).

The content of essential oil in leaves and containing eugenol at different times of the year also has variation.

##### 3.1.5 *Camellia sasanqua* Thumb.

The scientific name is *Camellia sasanqua* Thumb., which belongs to the Theaceae family, locally known as “Trà mai, cây sỡ”. *Camellia sasanqua* Thumb plant is a small plant, about 5-7m high, leaves have no stalk, pointed tip, narrow stalk side, serrated edge. *Camellia sasanqua* Thumb plant grows wild in many mountainous areas from north to south in the Truong Son mountain range. Today, *Camellia sasanqua* Thumb plant is grown most in Vinh Phuc, Phu Tho, Hoa Binh, Ha Tay, Ninh Binh, Bac Ninh, Bac Giang, Tuyen Quang, Lang Son. Cao Bang, Thanh Hoa, Nghe An, Ha Tinh, Quang Binh, Quang Tri, Thua Thien Hue province.

In the leaves containing 0.5-1% essential oil, the main ingredient of the essential oil is eugenol at the rate of 90-95%. Fatty oil pressed from *Camellia sasanqua* Thumb seeds are used to cook soap or prepare food.

#### 3.2 Changes in the Essential Oil and Eugenol of the Leaves of Some Useful Essential Oil Plants with High Eugenol Content during the Year

Figs. 1 and 2 show that at the time of June and September the essential oil content of the fresh leaves and the eugenol content in essential oils

are both low. According to research by Professor Le Ngoc Thach, there are many factors affecting the content and quality of essential oils such as type of plant, soil, fertilizer, environment, weather, light, time of harvesting, growth time of leaves. Thus, both young leaves and old leaves give low content and quality of essential oils [20]. For the essential oil plants growing wild, due to lack of seed selection, fertilization, and watering, its growth depends mainly on the soil and weather environment. In the dry season in Vietnam, from November to April of the following year, wild

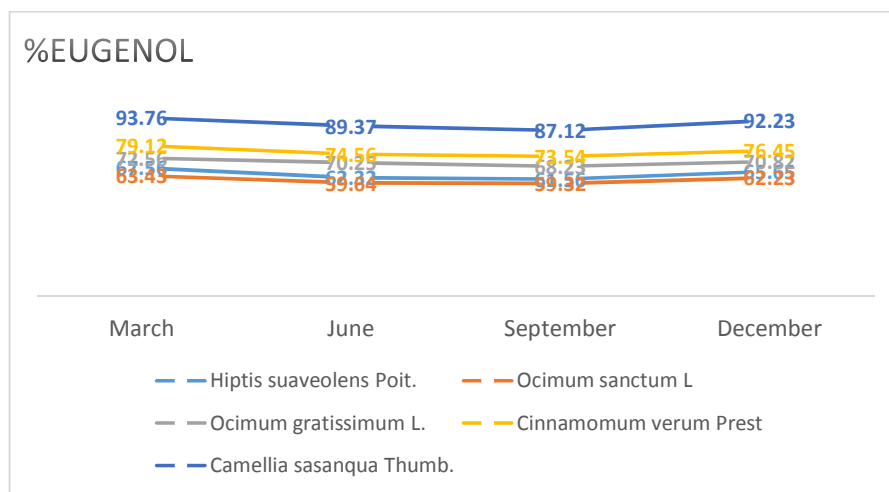
plants usually grow more slowly than the rainy season from May to October. In the middle of the rainy season, around June to September, the plants grow rapidly, many young shoot branches are sprouted, so there are many young leaves on the plant, leading to a decrease in the content and quality of essential oils. Although the essential oil index and eugenol content of the essential oil is lower in the rainy season than in the dry season, however, due to the strong growth of plants in the rainy season, more essential oils are harvested from leaves.

**Table 1. The plants with essential oils containing eugenol in Vietnam**

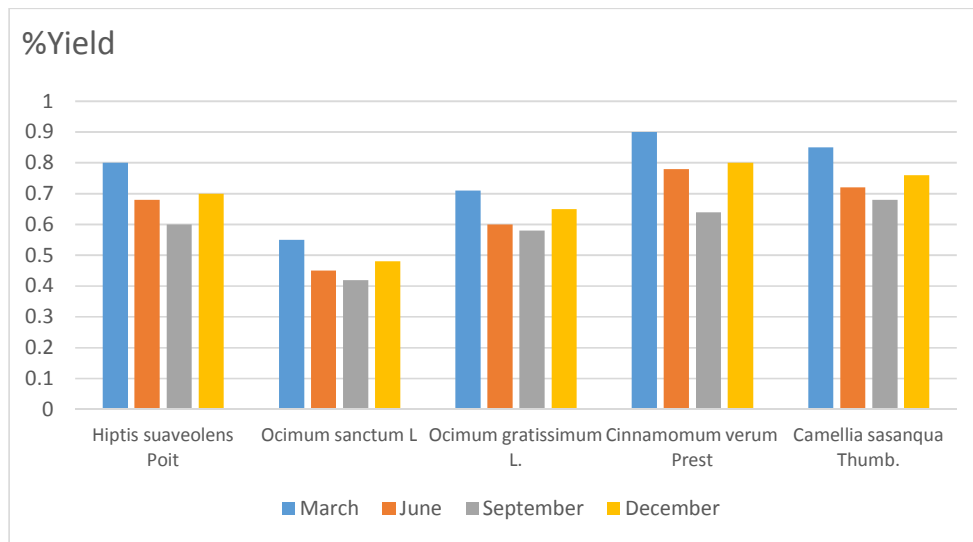
N <sub>o</sub>	The scientific name of plants	Family	%Yield	%Eugenol	Part of plants
1	<i>Angelica sinensis</i> Diels.	Apiaceae	0.1-0.3	4-5	Roots
2	<i>Foeniculum vulgare</i> Linn.	Apiaceae	0.2-0.4	4-6	Leaves
3	<i>Hiptis suaveolens</i> Poit.	Lamiaceae	0.5-1.0	62-67	Leaves
4	<i>Ocimum sanctum</i> L. <i>Ocimum tenuiflorum</i> L.	Lamiaceae	0.4-0.6	60-65	The part on the ground
5	<i>Ocimum gratissimum</i> L.	Lamiaceae	0.6-0.9	65-75	The part on the ground
6	<i>Pogostemon cabil</i> Benth.	Lamiaceae	0.6-0.9	5-10	Leaves
7	<i>Cinnamomum verum</i> Prest	Lauraceae	0.4-0.8	75-80	Leaves
8	<i>Piper betle</i> Linn.	Piperaceae	0.2-0.3	28-32	Leaves
9	<i>Camellia sasanqua</i> Thumb.	Theaceae	0.5-1.0	90-95	Leaves
10	<i>Artemisia vulgaris</i> L.	Asteraceae	0.2-0.4	4-6	The part on the ground

**Table 2. The content of essential oils and the main component of leaves, bark, and roots of *Cinnamomum verum* Prest**

N <sub>o</sub>	Parts of the plant	%Yield	Main component
1	Leaf	0.4-0.8	75-80% eugenol
2	Back	0.5-0.9	70-75% Cinnamaldehyde
3	Root	0.1-0.2	5-8% Cinnamaldehyde



**Fig. 1. The change of eugenol of fresh leaves of some useful essential oil plants with high eugenol content during the year**



**Fig. 2. The change of essential oil content of fresh leaves of some useful essential oil plants with high eugenol content during the year**

#### 4. CONCLUSION

We have made a list of the plant with essential oils containing eugenol in Vietnam. *Ocimum gratissimum* L., *Cinnamomum verum* Prest, *Camellia sasanqua* Thumb., *Ocimum sanctum* L., *Hiptis suaveolens* Poit are essential oil plants with high eugenol content that grow wild and are being cultivated in Vietnam, can be exploited to obtain eugenol sources for pharmaceutical and aromatic industries. We found that during the rainy season from June and September, the essential oil content in the fresh leaves and the eugenol content in the essential oils were low, but due to the strong growth of the plants in the rainy season, a lot of fresh leaves can be harvested, which mean there are more essential oils presented to be extracted.

#### CONSENT

It is not applicable.

#### ETHICAL APPROVAL

It is not applicable

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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