

DOI: <https://doi.org/10.38027/iccaua2023en0329>

Multi-purpose Plants of Essential Oils in Residential Gardens

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Abstract

Plants have many benefits both aesthetically and healthfully. One type of plant that can be used in residential gardens is essential oil-producing plants. The content of chemical compounds in various types of essential oils have been known to have various bioactivities as well as other miscellaneous activities. This study aims to identify the role of essential oil plants in providing benefits to the environment. This study uses qualitative research methods with persuasive writing. The results of this study found that some essential oil plants include *Rosmarinus officinalis*, *Ocimum basilicum*, *Mentha arvensis*, *Mentha piperita*, *Foeniculum vulgare*, *Cymbopogon nardus*, rose, and pandanus. The role of essential oil plants are anti-inflammatory, flavoring, fragrance, fungitoxicity, antimicrobial, fertilizer, antidiabetic, antihypertensive, repellents, and biopesticides. In addition, essential oil plants can also be used as aromatherapy, salad vegetables and herbs. Therefore, essential oil plants have enormous potential to be developed as multi-purpose plants for residential environments.

Keywords: Bioactivity, Chemical Compound, Essential Oils; Residential Gardens.

1. Introduction

Indonesia is a tropical country that tops the list of countries at risk for mosquito-borne infectious diseases. From year to year there are still cases of sufferers of mosquito-borne diseases such as malaria, dengue fever, chikungunya, and others. Mosquito-borne diseases pose a significant challenge in Indonesia and other areas. The use of synthetic insecticides and the emergence of insecticidal resistance have raised environmental concerns, necessitating the exploration of alternative mosquito control agents that are environmentally friendly. Moreover, the increasing resistance of pathogenic microorganisms to antibiotics has become a growing issue.

Aromatic plants are valuable additions to outdoor spaces due to their natural release of essential oils into the air when their leaves are rubbed or crushed. They possess the ability to serve multiple purposes in a garden, including being used for cooking and home remedies. This makes them versatile and beneficial for various tasks in any garden setting. Additionally, their pleasant aroma and potential health benefits make them a desirable choice for many gardeners. Adding a few aromatic plants to an existing garden can transform the landscape into a fragrant oasis. On the other hand the assessment of current amenities within Indonesian urban parks is necessary due to inadequate planning. Deficiencies such as the absence of aromatic plants for olfactory stimulation, the lack of noise-reducing plants to minimize disturbances, and insufficient infrastructure that accommodates visitors of all ages, including appropriate track widths and lengths, require attention (Massie et al., 2020; Sari et al., 2023). Aromatic plants offer both psychological and physiological benefits. These plants possess fragrances that have the potential to uplift mood, alleviate depression, and create a positive and stimulating atmosphere. Inhaling the aromas of aromatic plants has been shown to improve the mood and emotions of individuals (Jo et al., 2013). In addition Jo et al. (2013) reported that the physiological and psychological impacts of floral fragrance support the commonly known experiential understanding of the effects of scent on humans. They provide evidence that the benefits of interacting with plants are not only derived through visual perception but also through other sensory means such as the sense of smell. This strongly suggests that the therapeutic use of plants should target multiple senses to have an optimal impact on physical, mental, and psychological health conditions.

Essential oil is a volatile and lipophilic substance that consists of a combination of different organic compounds with generally low molecular weight. These oils, also known as etheric oils or flying oils, are produced in various plant organs such as roots, stems, leaves, fruit, flowers, seeds, and bark. Essential oils are characterized by their ability to evaporate at room temperature due to their volatile nature, and they possess a strong aroma (Dhifi et al., 2016). These aromatic plants and flowers are not only known for their delightful scents but also reputed for their therapeutic qualities. These volatile oils contained in herbs are responsible for different scents that plants emit. They are widely used in the cosmetics industry, perfumery, and also aromatherapy. The latter is intended as a therapeutic technique including massage, inhalations, or baths using these volatile oils. The last key will serve as chemical signals allowing the plant to control or regulate its environment (ecological role): attraction of pollinating insects, repellent

to predators, inhibition of seed germination, or communication between plants (emission signals chemically signaling the presence of herbivores, for example) (Dhifi et al., 2016). As part of a program to identify essential oils plant as alternative larvicidal and antimicrobial agents, hence there is a need to discover new and alternative insect-control agents and antimicrobial agents. In this work, seven essential oils plants have been selected. This study aims to identify the role of essential oil plants in providing benefits to the environment.

Residential Gardens

Residential or home gardens or yards refer to the spaces where individuals engage with nature on a daily basis, and these spaces are privately owned by residents. This area is commonly known as the 'yardscape' or the open areas surrounding urban and suburban homes (Barnes et al., 2020). Park therapy components, such as plants, flowers, and the sky, exhibited a negative correlation with negative moods and anxiety levels. The presence of a campus green space that offers a clear view of the sky, appropriate planting design, and captivating landscape elements has the potential to alleviate psychological disturbances among the academic community. This implies that incorporating natural elements into the environment, such as plants, flowers, and the sky, can counteract negative emotions and anxiety levels, benefiting the well-being of individuals within the academic community (Pratiwi et al., 2022). Having an adequate number of green spaces that are easily accessible within urban neighborhoods can contribute to a better understanding of the role of green infrastructure and encourage positive environmental behaviors among both the urban population in Nigeria and elsewhere. The availability and accessibility of sufficient green areas in urban neighborhoods have been associated with various benefits such as improved physical health, mental well-being, reduced stress levels, and enhanced overall quality of life for city dwellers (Dipeolu et al., 2022; Amen, 2021; Aziz Amen, 2022; Amen et al., 2023; Amen & Nia, 2020). Gardening encompasses the cultivation of both food crops for home consumption and ornamental plants for aesthetic purposes. The relative popularity of these two main trends can vary based on culture and socio-economic background (Chalmin-Pui et al., 2021).

Repellent

Repellent is an insect repellent substance made from various kinds of plants that contain compounds disliked by insects. Repellent easily decomposes, which prevents pollution in the environment and makes it relatively safe for humans. A mosquito repellent is a substance that is applied to the skin, clothing, or other surfaces to discourage insects and arthropods from landing or climbing on that surface. It can also come in the form of products that use sound production, particularly ultrasound, to repel mosquitoes. A substance called repellent can be applied to the body's outer surface to provide personal protection against mosquito or insect bites. The repellent available in the market contains N, N-diethyl-3-methylbenzamide (DEET), which has demonstrated satisfactory results in preventing mosquito or insect bites (Katsambas et al., 2015).

2. Material and Methods

The method used in this study is a qualitative research method. Data are presented in narrative and figures are obtained from interviews, personal documents, field notes, and literature. Furthermore, the data were analyzed descriptively.

The object of this research is essential oil plants found in residential house. The author made observations of the type and number of essential oil plants planted in each residential house and the author's living environment. There are 28 houses. The twenty-eight houses are composed of 2 rows of houses, each row there are 7 pairs of houses facing each other.

3. Results

Based on the results of the identification of essential oil plants that have been carried out there are seven essential oil plants planted. The seven essential oil plants are pandan, rose, basil, citronella, mint, fennel, and rosemary respectively as shown in Figure 1.

Some essential oil plants are prepared to repel certain types of insects. Some of these essential oil plants function as insecticides, while others only act as insect repellents. In addition, some insect repellents can kill insects, while others are only repellents. Basil (*Ocimum basilicum*), Citronella oil (repels mosquitos), Fennel oil (*Foeniculum vulgare*) (mosquitos), Citronella grass (*Cymbopogon species*) (mosquitos), Peppermint oil (*Mentha x piperita*) (mosquitos), Rosemary (*Rosmarinus officinalis*) (mosquitos) (Baruah & Borthakur, 2016).

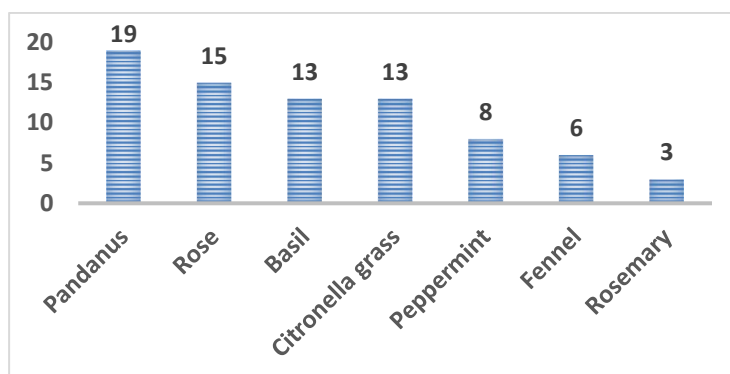


Figure 1. Seven Type of Essential Oil Plants

4. Discussion

a. Pandanus

Based on Figure 1 the most widely planted pandan plants. This is because the pandan plant has a pleasant aroma which is usually used in Indonesia and other Southeast Asian countries as a natural aroma which is added to various traditional snacks. Besides that, pandan leaves are also used as a fragrance when cooking rice and also glutinous rice, so that the rice smells like fragrant pandan rice. Especially during Ramadan almost every day cooking dessert by adding the aroma of pandan. According to Figure 1, it was obtained the most compared to other essential oil plants, namely 19 pandanus plants or 24.67%.

Pandanus amaryllifolius Roxb., commonly known as pandan, is a tropical plant that accumulates the highest concentration of the major basmati aroma volatile 2-acetyl-1-pyrroline (1-(3,4-dihydro-2H-pyrrol-5-yl)ethenone) (Figure 2) in the plant kingdom (Bhatt et al., 2021). 2-acetyl-1-pyrroline has commercial significance as a flavor constituent that imparts the characteristic aroma of scented rice varieties such as basmati rice in India and in several Asian rice varieties for example pandan wangi from Indonesia. In addition, pandan leaves extract contains bioactive compounds such as tannin, alkaloids, flavonoids, and polyphenol. According to Aini & Mardiyarningsih (2009) when used in a concentration of 15%, pandan leaves extract has been found to decrease the total plate count and number of mold in traditional food. However, it fails to provide an appetizing flavor and fragrance to the food product. Figure 1 The Pandanus Leaf (Personal Documentation, 2023) and Molecular Structures of 2-acetyl-1-pyrroline

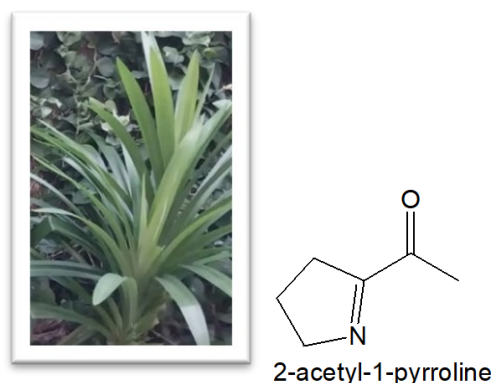


Figure 2. The Pandanus Leaf (Personal Documentation, 2023) and Molecular Structures of 2-acetyl-1-pyrroline

The aroma produced by fragrant pandan leaves has a relaxing effect. This has implications for its use as an ingredient for traditional Batak saunas (Silalahi & Nisyawati, 2018). Bioactivity of *P. amaryllifolius* as antimicrobial, various studies have successfully demonstrated the ability of *P. amaryllifolius* leaf extract to inhibit the growth of various types of bacteria including *S. aureus* and *Pseudomonas aeruginosa* (Dumaoal et al., 2010), *S. aureus* and *E. coli* (Mardiyarningsih & Aini, 2014), and *Shigella dysenteriae* (Ariana, 2017). Mardiyarningsih & Aini (2014) *S. dysenteriae* is a pathogenic bacterium that causes dysentery which causes ulcers in the colon (Ariana, 2017). In addition, pandanus compounds are better in terms of causing mortality of *Sitophilus oryzae*. Besides that, pandan wangi leaf extract can also be used as a fly repellent (Ismanto et al., 2020).

b. Rose

Figure 1 shows the results that obtained 15 rose plants. In this study, roses were chosen because they have a beautiful shape and color and have a fragrant aroma. The overall yield of roses is 19.48%. Plants from the Rosaceae

family are highly valued and employed in the food, perfumes, and cosmetics because they are abundant in natural compounds with advantageous biological qualities.

Rose flowers contain chemical compounds including citronellol (28.72%), geraniol (21.40%), nerol (4.2%), linalool (1.9%), farnesol (1.90%), tannins, geranic acid, terpenes, flavonoids, polyphenolic pectins, vanillin, stearoptene, eugenol, phenylethylalcohol (Mileva et al., 2021). Figure 3 shows some of molecular structures of rose chemical compounds.

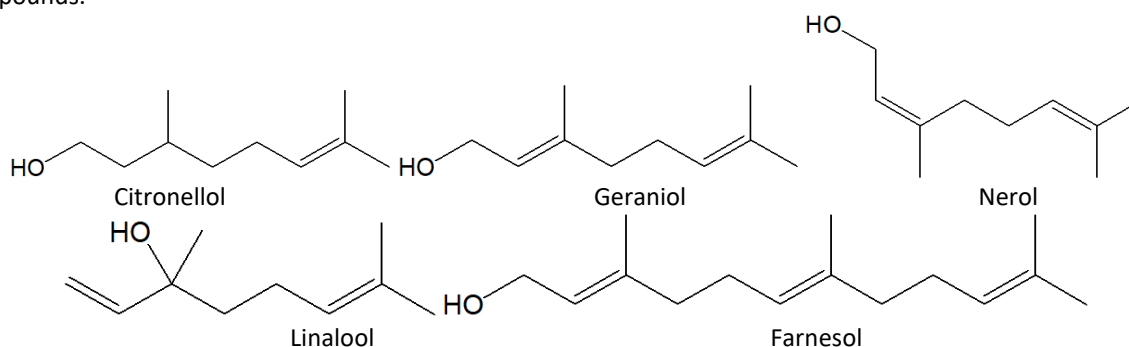


Figure 3. Molecular Structures of Nerol, Gernaioi, Nerol, Linalool, and Farnesol.

C. Basil

The results showed that the basil plants were 13 or 16.80% (Figure 1). Basil plants are the choice for planting because they are often used as salads and also as ingredients for making pepes which is traditional food from West Java, Indonesia.

Basil plant scientifically known as *Ocimum basilicum* L. (*O. basilicum* L.) is one of the producing plants essential oils grown in worldwide and also in Indonesia. The chemical compositions of essential oils of *O. basilicum* include methyl chavicol (estragole), cineole, eugenol, methyl eugenol, elemicin, myristicin, rosmarinic acid, linalool, apigenin, ursolic acid, and methyl cinnamate ((Aminian et al., 2022). Figure 4 shows the Plant of *O. basilicum* L. and the molecular structures methyl eugenol, eugenol, methyl cinnamate, elemicin.

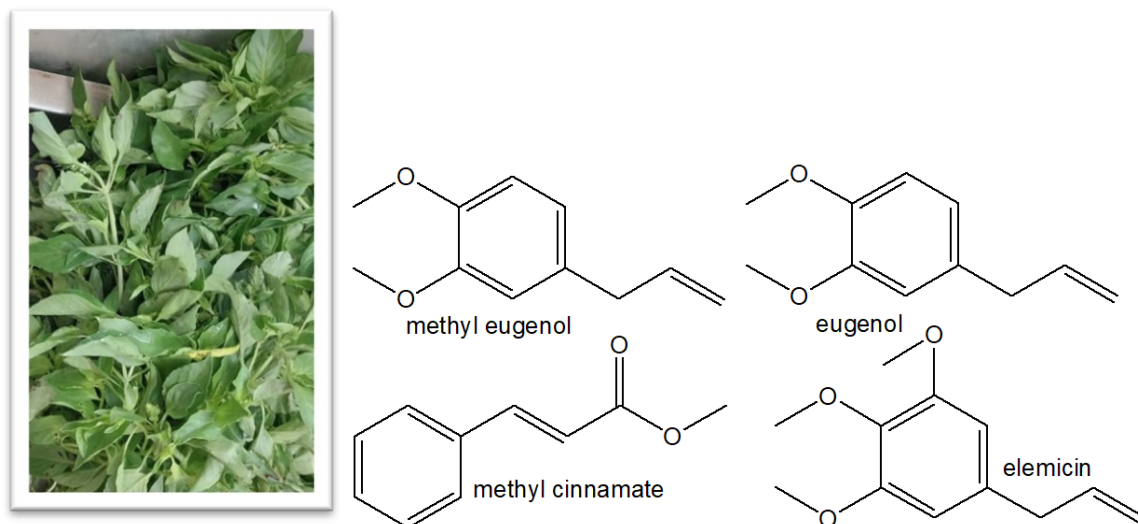


Figure 4. The Plant of *O. basilicum* L. (Personal Documentation, 2023) and the Molecular Structures Methyl Eugenol, Eugenol, Methyl Cinnamate, and Elemicin

Ocimum basilicum, is a plant that has been applied in the food, pharmaceutical and skin care industries and also traditionally used in traditional medicine for the treatment of respiratory disorders. It is known to have various therapeutic effects in respiratory diseases such as asthma, bronchitis, and cough, as well as gastric disorders (Othman et al., 2021), cardiovascular diseases (Abidoye et al., 2022), neurocognitive and metabolic disorders (Heshami et al., 2021). On the other hand Wahyuni & Yulianto (2017) the concentration of 50% basil extract is most effective against Knockdown Time in mosquitoes and basil leaf extract can be used as a liquid vegetable insecticide and as an alternative to fogging.

d. Citronella Grass

The results showed that the citronella grass plants were 13 or 16.80% (Figure 1). This plant is widely used in households as an ingredient for making various food and drinks.

Citronella grass, scientifically known as *Cymbopogon nardus* is a perennial grass from family Poaceae growing in tropical and subtropical regions in the worldwide. Essential oils from *C. nardus* are known as citronella oil, with three main active components, namely 3,7-dimethyloct-6-enal (citronellal), 3,7-dimethyloct-6-en-1-ol (citronellol), and (E)-3,7-dimethylocta-2,6-dien-1-ol (geraniol) (Wany et al., 2014). Citronella essential oil is a valuable essential oil widely used in the cosmetic and pharmaceutical industries. It holds significant commercial importance and is highly sought after in both national and international markets. This essential oil is derived from a perennial grass known as citronella. Citronella essential oil finds multiple applications in the cosmetic and pharmaceutical sectors due to its diverse properties and benefits. Commercial cultivation of citronella grass is primarily concentrated in the southeastern regions of Asia, specifically in countries such as Burma, Sri Lanka, India, Ceylon, Taiwan, Indonesia, as well as in the West Indies.

Citronella is used for rheumatism, menstrual problems, fevers, and intestinal parasites (Kaur et al., 2021). Figure 5 Shows the Molecular Structures of citronellal, citronellol and geraniol.

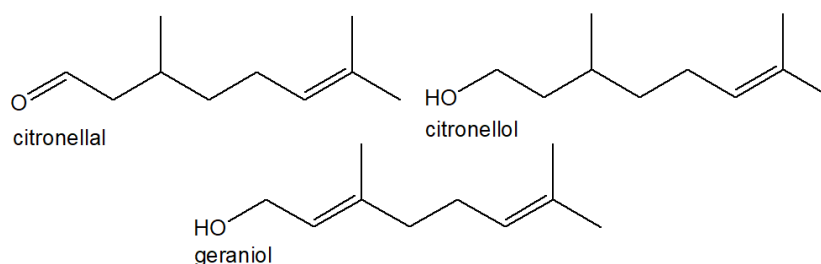


Figure 5. The Molecular Structures of citronellal, citronellol and geraniol

Variable composition contributes to the impressive insecticidal, fungicidal, herbicidal, and antioxidant properties displayed by essential oil. This natural oil serves as an affordable, environmentally friendly, and efficient alternative to synthetic chemicals. In addition to its biological potential, essential oil can be utilized as a bioadditive (Rizal et al., 2017). Furthermore, it has the potential to be employed as a substitute for future formulations of mouthwash (Cunha et al., 2020).

e. Mint

The results showed that there were 8 or 10.39% mint plants (Figure 1). Mint plants are often used to make drinks and garnishes for food. Mint is the common name for over 20 perennial species of plants belonging to the genus *Mentha*, family Lamiaceae. The genus *Mentha* includes economically significant plants that serve as sources of raw materials for flavor and fragrance. The most significant mint species worldwide include spearmint (*Mentha spicata*), peppermint (*M. piperita*), and Japanese mint (*M. arvensis*) (Fancello et al., 2017). These plants, commonly known as mints, hold commercial value and are utilized in the production of herbal formulations, cosmetics, pharmaceuticals, and the food industry. Japanese mint (*Mentha arvensis* L.) and *Mentha piperita* L. have similar lengths in terms of their botanical names. The information about these plants being herbal plants, their cultivation, and their commercial value remains the same (Wei et al., 2023). Figure 6 shows peppermint plants on the wall using hydroponics system.

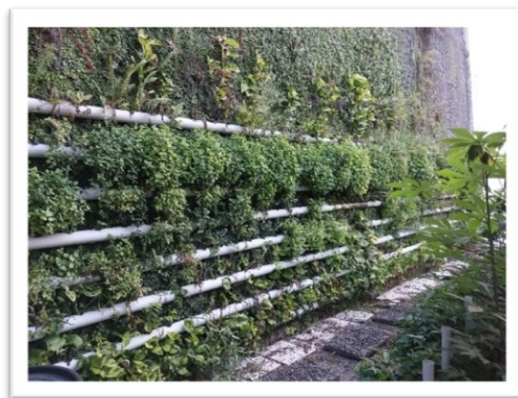


Figure 6. Peppermint Plants on the Wall Using Hydroponics System (Personal Documentation, 2023)

The hydro-distillation of mint aerial parts produces essential oil, and the chemical composition of the essential oil varies depending on the species of mint. *M. arvensis* essential oil is characterized by a high proportion of isomenthone and menthol, while *M. spicata* essential oil is rich in limonene, carvone, and caryophyllene (Golestan et al., 2016). On the other hand, *M. piperita* essential oil is known for its richness in menthol and menthyl acetate (Wei et al., 2023). Figure 7 shows molecular structures of menthone, menthyl acetate, and menthol.

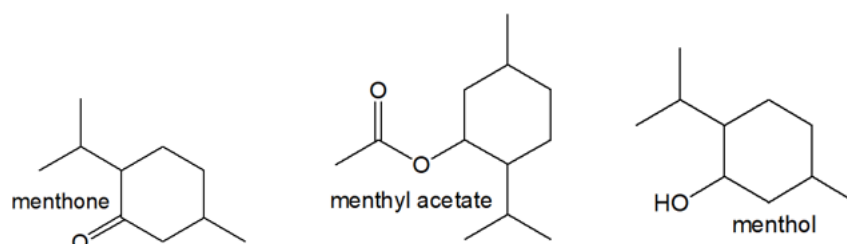


Figure 7. Molecular Structures of Menthone, Menthyl Acetate, and Menthol

Mentha species are known for their great chemical diversity and have been reported to contain a variety of chemical compounds responsible for pharmacological properties as antioxidant, antibacterial, antifungal and antiyeast, and also antiviral (Tafrihi et al., 2021). These species have been extensively studied for their medicinal and therapeutic effects. Studies on the antifungal activities demonstrated that the essential oils of *Mentha × piperita* and *Mentha arvensis* exhibited inhibitory effects on the growth of *Candida* species and hindered the formation of biofilm. The antifungal activity of *Mentha × piperita* essential oil was found to be comparable to that of amphotericin-B. These findings suggest that the essential oils from *Mentha × piperita* and *Mentha arvensis* have potential as natural agents for controlling fungal infections caused by *Candida* species, including those that are resistant to conventional antifungal drugs (Wei et al., 2023). In addition Fauzi & Prastowo (2021) show that the best treatment for causing repellency against *Sitophilus oryzae*, the rice weevil, was the treatment using 10 grams of pandanus with a repellency percentage of 87.5%.

f. Fennel

According Figure 1 shows that there were 6 fennel plant or 7.80%. The fennel plant can be used as a salad and to make vegetables. In addition Fahruroz et al. (2020). In addition, Fahruroz et al. (2020) patent regarding the Process for Making Balsam Made from Mainly Basil Leaves and Stems namely this invention aims to provide a process for making balsam. Fennel essential oil is commonly used to make telon oil, which is a mixture consisting of fennel oil, eucalyptus virgin oil, and coconut oil (VCO).

Foeniculum vulgare Mill., commonly called fennel is one of the most popular perennial herbaceous plants used as herbal medicine and spices worldwide. It belongs to the family Umbelliferae or Apiaceae and is characterized by a distinct floral arrangement with an umbrella-like shape. In addition to other well-known Umbelliferae plants, such as carrot, celery, and angelica, fennel has been utilized ethnobotanically to cure various ailments, including gastrointestinal issues, hormonal disorders, reproductive, and respiratory diseases (Jadid et al., 2023). A wide range of bioactive compounds from *F. vulgare* Mill., have been extensively studied. These compounds include phenols, phenolic glycosides, and volatile aroma compounds such as anethole, estragole (methyl chavicol), and fenchone, which are reported as its major components of *F. vulgare* seed essential oil (Rather et al., 2016). Their plant and molecular structures are shown in Figure 8 and 9.



Figure 8. The Plant of *F. vulgare* Mill. (Personal Documentation, 2023)

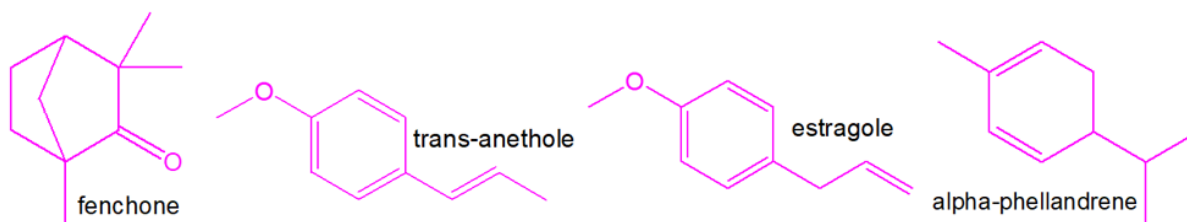


Figure 9. The Molecular Structures of Fenchone, Trans-anethole, estragole, and Alpha-phellandrene

Rosemary

In this study the rosemary plant obtained 3.90% (Figure 1). Rosemary, scientifically known as *Rosmarinus officinalis* L., is a fragrant plant belonging to the Lamiaceae family. It is widely used as a culinary spice and is consumed as a food ingredient. The essential oil content derived from the leaves of *Rosmarinus officinalis* L. was found to be 0.93 g per 100g of the plant material. Gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) analysis of the essential oil revealed the presence of several major components. The major component identified in the essential oil of *Rosmarinus officinalis* were as follows: 1,8-cineol or eucalyptol (38.5%), camphor (17.1%), α -pinene (12.3%), limonene (6.23%), and camphene (6.00%) (Hussain et al., 2010). The rosemary plant and molecular structures of the major components of *R. officinalis* essential oil are given in Figure 10.

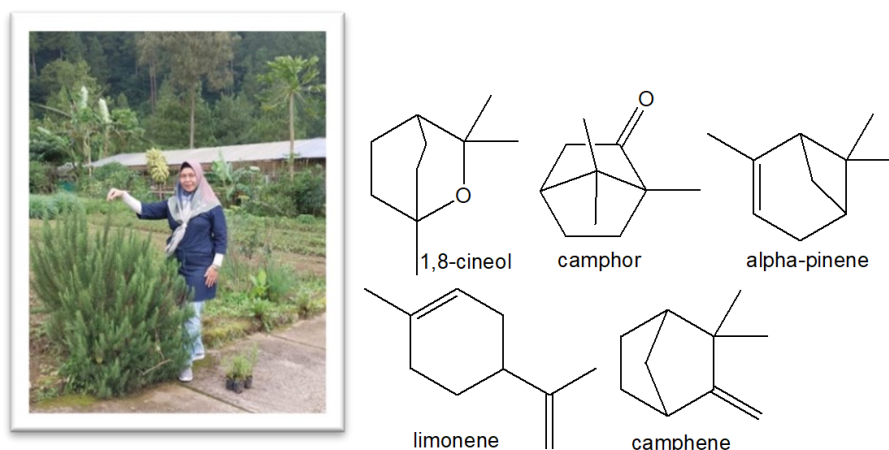


Figure 10. The Rosemary plant (Personal Documentation, 2023) and Chemical Structures of 1,8-cineol, camphor, α -pinene, limonene, and camphene

The results of research on essential oil plants, besides being able to be reproduced to be planted in residential garden, also have the potential to be planted in university parks or other public parks. This is supported by research (Pratiwi et al., 2022) dan (Chalmin-Pui et al., 2021). Because essential oil plants can also act as repellents, these plants have the potential to be planted in university parks and other parks. so that people who are enjoying the garden to relieve stress and refreshing can avoid mosquito bites and harmful insects. Essential oil plants also have the potential as aromatherapy because they can promote a sense of peace and help to prevent restlessness and anxiety.

5. Conclusions

1. Identification of essential oil plants in residential parks resulted in seven types of essential oils yaitu pandan, rose, basil, citronella, mint, fennel, and rosemary respectively as shown
2. Essential oil plants are multi-purpose plants because they can be used as ingredients for food and beverages, medicines, and cosmetics. It can also be used as a repellent. Besides that, the pleasant aroma of essential oil plants in housing can also be used as aromatherapy.

Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interests

The authors declare no conflict of interest.

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