Mustansiriyah Journal of Pure and Applied Sciences

www.MJPAS.com

# Antioxidants in the volatile oils of medicinal plants

Radhiyah Ali Hasan Ahmad[1] Suha Dhia Abid Ali Twaij[2]

[1,2] Department of Biology / College of Education for Pure Sciences Ibn Al-Haitham , radia.a.h@ihcoedu.uobaghdad.edu.iq[1] , suha.d@ihcoedu.uobaghdad.edu.iq[2]

**A B S T R A C T**

Medicinal plants have been used since ancient times in the treatment of diseases, and this is confirmed by scientists and sages, where herbal medicine is the oldest known method of medicine, and a number of countries still rely on plants to treat their diseases. The World Health Organization (WHO) has pointed out a large number of the world's population depends on the use of medicinal herbs as a primary medicine for the treatment of a number of diseases. The global census of medicinal plants is estimated at about 300,000 species, and only 2,500 plants are classified, as there are in some parts of medicinal plants more than 50 compounds and one of the most important effective compounds found in medicinal plants are volatile oils or aromatic oils.

.***Keywords***: *Antioxidants, medicinal plants , volatile oils***.**

## 1.Introduction

Plants are the main source of the production of herbal volatile oils, followed by animal sources of amber, which is extracted from the amber whale, and musk, which is extracted from deer. The plantae kingdom includes more than 2000 plants containing volatile aromatic oils, which represent about sixty plant families, the most important of which are: Rosaceae, Asteraceae, Myrtaceae, Lamiaceae, Apiaceae, Rutaceae, Leuraceae, Pinaceae and Geraniaceae.Aromatic oils, which are organic compounds that are responsible for giving the plant a distinctive smell and they are easily separated from the plant parts containing them by different extraction methods. They are called volatile oils because they are characterized by evaporation and volatilization without decomposition at room temperature and they are also called essential oils for the human need for them in his food and the inability of the enzymatic cellular system in the human body to synthesize them or ethereal oil because it is soluble in alcoholic compounds such as ether, and it does not contain in its molecules fatty

*Corresponding author : Radhiyah Ali Hasan
E-mail address: radia.a.h@ihcoedu.uobaghdad.edu.iq

acids or glycerin, so it does not rancid when exposed to direct air or light, unlike fixed oils that do not volatilize, but decompose when exposed to high temperatures. Volatile oils are found in the tissues of various plant parts such as leaves, flowers, roots and stems.

**1-1- Chemical composition of volatile oils**

Terpenes are the basic compounds of volatile aromatic oils, which consist of building units called isoprene chemical symbol $C_5H_8$ "Fig 1. A " linked with a diphosphate group to form the compound isopentenyl pyrophosphate, which is the effective form of isoprene in the construction of volatile oils, it is built by two paths:

1. The Acetate mevalonate pathway is done in cytosol through the use of two units of Acetyl-CoA obtained from two sources as follows:
   a. The first source is through the catabolism of fatty acids in the glyoixsomes matrix by the process of β-oxidation as eight units of Acetyl-CoA are produced by the catabolism of the fatty acid Palmitate.
   b. The second source of amino acid catabolism and the formation of pyruvate which results in two units of Acetyl-CoA.
2. D-xylulose-5-phosphate pathway is done using pyruvate, which results from the catabolism of sugar in the mitochondria during cellular respiration through the Krebs cycle, as Malate turns into Pyruvate, or by turning Glucose-6-phosphate through a series of glycolysis reactions into Pyruvate, this process takes place in plastids.

Volatile oils are chemically composed of two types of compounds:

1. Oleoptenes hydrocarbons, which represent the liquid fraction of volatile oil.
2. Oxygen compounds (Stearoptenes) include solids dispersed in the liquid part of the oil, which is attributed to the therapeutic and physiological effect, as well as it carries the smell and taste of the volatile oil.

**1-2-Production sites of volatile oils in plants**

The volatile oil in the chamomile plant is produced from one of the metabolism pathways and collected in plant tissues inside specialized secretory structures, which are external secretory structures spread on the outer surfaces of the skin in the stems, leaves and flowers, and are responsible for oil production and assembly.

The researchers showed that the sites of production and storage of volatile oils in plants are carried out in special vascular structures equipped with walls that prevent their volatilization, the most important of which are:

a. Specialized secretary structures

   They are glandular appendages or hairs that represent the extension of the upper or lower epidermal cells of the juicy stems, flower petals or leaves, such as in the glandular hairs in the plants of the Asteraceae family and they are sessile or petiolate buried inside cavities between the epidermal cells, which reduces oil volatilization from them.

b. Oil Channels

   They are tubes that secrete essential oils from their inner walls found in plants of the Umbellifera family.

c. Oil Glands

They are mutated parenchyma cells found in many plant families such as the Rutaceae and Lamiaceae families.

## 2-The most important plants producing volatile oil

### 2-1- Chamomile plant

2-1-1--Botanical description of the chamomile plant

Chamomile "*Matricaria chamomilla* L. " is one of the most important and famous medicinal and aromatic plants, follows the Asteraceae family, widely used since ancient times in most parts of the world for its medicinal and therapeutic importance.

It is a herbaceous annual winter plant, the long day plant and has a distinctive aromatic smell up to a height of about 80 cm stem erect, compound pinnate leaves with a dark green color, its flowers are compound dichasium consisting of two types of flowers:

a. White ligulate florets, which is a single row of adjacent flowers found in the outer periphery of the hollow receptacle, limited in number, ranging in number between 12-20 flowers.
b. Tubular yellow disc flowers, small in size, numerous in numbers, covering the surface of the hollow receptacle. The diameter ranges from 1.5 to 2 cm, the seeds are very small; numerous in number, with a gray to blackish brown color"Fig 1.B".

Chamomile has two common types widely used in the world of medicinal herbs:

1. German or Hungarian chamomile "*Matricaria recutita* and *Matricaria chamomilla*".
2. Roman or English chamomile "*Anthemis nobilis* or *Chamomelum nobilis*" herbaceous perennial plant grows parallel to the ground stem purlin rises from the ground at the edges does not exceed a height of 30 cm, leaves similar to parsley leaves, thicker than the leaves of German chamomile.

2-1-2-The medicinal and nutritional importance of the chamomile plant

The researchers pointed out that the most important active compounds found in German chamomile are volatile oil, coumarins, flavonoids, glycosides, tannins and phenolic compounds.Volatile oil is a viscous blue liquid oil of heavy texture that freezes at zero degrees Celsius and has a characteristic pleasant odor specific to chamomile, the most important components of which are: Chamazulene, α-bisabolol, α-pinene, Limonine, Camphene, Spathulenol and β-trans farnesene.

The compound of chamazulene is characterized by its dark blue color, which gives its color to chamomile oil.

The Complete German Commission, a scientific advisory board of the Federal Institute for Drugs and Medical Devices in Germany formed in 1978, approved the use of chamomile as a treatment for respiratory infections, mucous membranes, bacterial skin diseases and treatment of diseases of the urinary system. It helps stimulate the hormone thyroxin, stimulates blood circulation, relieves puerperal pain, strengthens nerves and brain, and treats rheumatic pain and headaches. It is a treatment for indigestion and an analgesic for abdominal pain, as well as a mouthwash, antiseptic and treatment for bacterial gum infections and insulin resistance in patients with type II diabetes.

As for its side effects, it is recommended that it should not be combined when taken with medicines containing iron because it works to withdraw iron because it contains tannin.

**2-2-Basil plant**

2-2-1-Botanical description of basil plant

Basil "*Ocimum basilicum* L. " belongs to Lamiaceae family, which includes about 200 species that are found in Asia and Africa, which are believed to be the original habitat of the plant"Fig 1.C".

2-2-2-The most important types of the genus *Ocimum*:

1. Sweet basil *Ocimum basilicum* L. sometimes classified from annual plants and other times from perennial herbaceous plants, which is one of the most widespread varieties characterized by its strong growth and branching, especially in the upper parts, and reaches a height of 60-100 cm either leaves they are lanceolate or ovate dark green color.

   While the flowers are white to purple color, this species is used in eating and is used in the pharmaceutical and economic industries, and the varieties that belong to it are sweet basil or ordinary *Ocimum basilicum* L., *Ocimum basilicum* L. "purple", *Ocimum basilicum crspatum* "purpurascens", *Ocimum basilicum* "cinnamon", *Ocimum basilicum* "minimum",*Ocimum basilicum* "minimal", *Ocimum basilicum* "sanctum" and *Ocimum basilicum* "citrodoro".
2. Pink basil "*Ocimum gratissim*" the height of this plant reaches 150 cm, and is characterized by the strength of its growth and prolific branching and with large serrated leaves with a tip and tapering end, its flowers bear on racemic inflorescences crowded.
3. Camphoric basil "*Ocimum dscharicumkilliman*" it is a dendritic perennial plant up to 190 cm high with a smell similar to the smell of camphor pink and white flowers, the plant is used for medicinal purposes.
4. Shrubby basil "*Ocimum viride*" the plant is characterized by its main woody stems, and many branching up to 150 cm high, ovate leaves small size serrated edge, flowers greenish-white color carry on inflorescences, used for medicinal purposes.
5. American basil "*Ocimum ameriecanum*" it is used for medical purposes as it helps to treat fever and is used as a spice as well.

2-2-3-The medicinal and nutritional importance of the basil plant

Basil is grown as a foliar crop for fresh food consumption or as an aromatic plant to extract effective compounds from it. The basil varieties contain many effective compounds, including volatile oil, which is concentrated in the leaves and consists of 140 compounds, the most important of which are Linalool, α-Pimene, Nerole, Limonene and Eugenol. They are antioxidant and antibacterial compounds and has a medical effect in the treatment of cancer and an anti-thrombosis and is used to preserve foods and foodstuffs such as meat and fish and works as a treatment for asthma, headache, fever, cough, cold and stimulate the immune system and a milk diuretic in women and in the manufacture of perfumes because it contains the nerol compound responsible for the strong smell in the plant .

**2-3- Mint plant**

2-3-1-Botanical description of the mint plant

Mint "*Mentha* sp. " from perennial aromatic plants belongs to Lamiacea family. The genus of mint is distinguished by its characteristic smell, can be classified under the genus *Mentha*

into: *Mentha spicata* L., *Mentha longifolia* L., *Mentha aquatica* L., *Mentha suaveolens* and *Mentha piperita* L.

The original habitat has the Mediterranean basin and Europe needs to grow well to a long and warm day and nights characterized by relatively lower temperatures to ensure the ideal composition of essential oil, grows in moist soils rich in humus, a rapidly growing perennial rhizomic plant up to 30-90 cm high stems smooth polygonal grow from them thick rhizomes fast spread carry fibrous roots, flowers purple in the form of inflorescences length of 6-8 mm, corolla is four leaves petals distributed spiral around the stem"Fig 1.D".

2-3-2-The medicinal and nutritional importance of the mint plant

Since ancient times, the leaves, flowers and stems of the mint plant have been used fresh or dried as spices and the preparation of herbal syrup or the use of its essential oil to treat headaches, disorders and poor digestion of the digestive system and fever, enters into many industries such as the manufacture of candy, perfumes, toothpastes and chewing gum, as well as its use as various pesticides.

Peppermint oil, which has a sweet taste in the treatment of fungal and bacterial skin diseases and anti-muscle spasms, is used to treat irritable bowel syndrome as well as used during intestinal examination using barium injection and enteroscopy to reduce intestinal spasms, and some mint oils rich in eucalyptol have shown effectiveness against cancerous tumors and osteoporosis .

**2-4- Anise plant**

2-4-1-Botanical description of anise plant

Anise "*Pimpinella anisum*" herbaceous plant with a height of about half a meter stem thin polygonal divided from it long branches carry rounded serrated leaves, bearing the end of the branches flowers oval shape pressed head white color combined in the form of an umbrella turn after maturity into small brown fruits. Anise seeds are oblong between 3.2 – 4.8 mm long, gray-brown in color, have a special aromatic aroma and a delicious sweet flavor"Fig 1.E".

2-4-2-The medicinal and nutritional importance of the anise plant

Anise plant has been used since ancient times as an antiviral, antifungal, antiparasitic, antibacterial and anti-insect and works as an expectorant, analgesic, antiseptic and anti-inflammatory and has a role in improving the digestibility of nutrients within the gastrointestinal tract and supports the effect of the Lypase and Amylase enzymes.

Anise contains anehol, which is the main compound in volatile oil, which is one of the compounds that help in the digestion of fats, as it works to promote the production of gastric juice as well as stimulate the secretion of intestinal and pancreatic juices. The anise drink is useful in the treatment of colds, cough, asthma, bronchitis, colic and indigestion, and is useful in the treatment of cases of diarrhea as well as in calming the nerves, especially in cases of stress and helps overcome cases of insomnia.

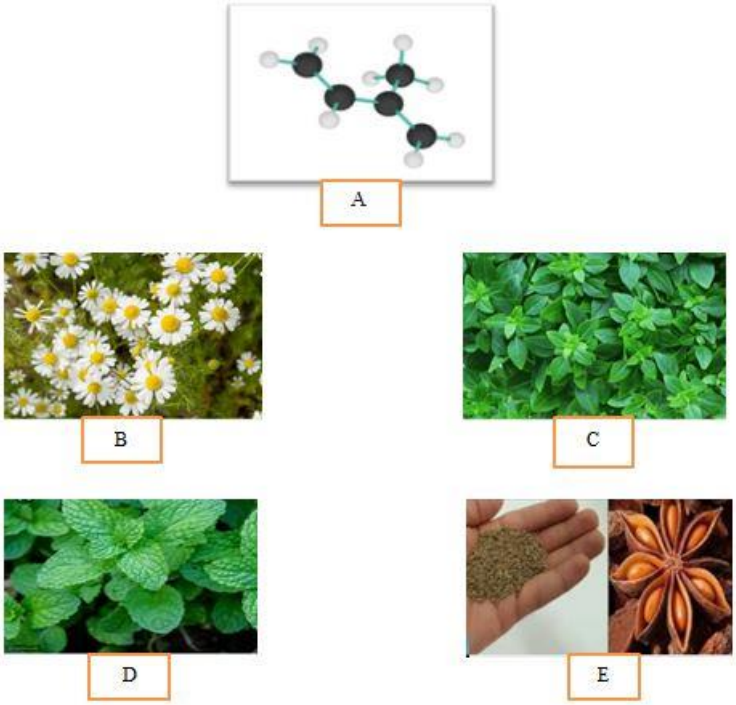


**Figure 1. A-** isoprene ($C_5H_8$) **B-**Chamomile plant **C-**Basil plant D-Mint plant E-Anise plant

## References

[1] Abbood,B.SA.(2020). Effect of salt stress and Jasmonic acid and Salicylic acid sprays on the growth and Production of the active compounds of *Matricaria recutitia* L. Master's thesis, College of Agriculture .University of Kufa.

[2] Ahmad,R.A.H.(2022). Respones of growth, flowers yield and active medicinal compounds Chamomile (*Matricaria chamomilla* L.) Plant to Bio-Organic Fertilization and kinetin. Ph.D. thesis. College of Agricultural Engineering Sciences. University of Baghdad.

[3] Akbari, G.H.A., Miri, S.A., & Zeinali, H. (2022). Investigating the effects of different fertilizers and cultivation media on the yield and active ingredients of *Zingiber officinale* Rosc. *J. Med. Plants* 21(84): 75-86.

[4] Al-Asadi, M. H. S. (2018). *The basics of medicinal plants and Their Active Constituents*. House of books and documents. Baghdad. Iraq pp. 243-276.

[5] Al-Khazraji, G. A. M. R. (2017). Effect of gibberellin, kinetin and NPK compound fertilizer on the growth and yield of star anise (*Pimpinella anisum* L.) and its content of some active compounds. Master Thesis., College of Basic Education, Al-Mustansiriya University.

[6] Ayeda, M.M., & Awda,J.M.(2023). Cytotoxic activity of basil seeds( *Ocimum baslicum* L) extracts on some breast cancer cell lines ( *in vitro*). *Iraqi Journal of Agricultural Sciences*:54(4):928-938. DOI: https://doi.org/10.36103/ijas.v54i4.1782

[7] Avonto, C; M.Wang, A. G. Chittiboyina; B. Avula; J. Zhao & Khan, I. A.( 2013). Hydroxylated bisabolol oxides: Evidence for secondary oxidative metabolism in *Matricaria chamomilla. Journal of natural products*, 76(10), 1848-1853.

[8] Bączek, K.B., Wiśniewska, M., Przybył, J.L., Kosakowska, O., &Węglarz, Z. (2019). Arbuscular mycorrhizal fungi in chamomile (*Matricaria recutita* L.) organic cultivation. *Ind. Crops Prod*. 140: 111562.

[9] Cifftci, M., Guler, T., Dalkilic, B. & Ertas, O. N. (2005). The effect of anise oil (*Pimpinella anisum L*.) on broiler performance. International *Journal of* Poulty. Science, 4(11): 851-855. https://scialert.net/abstract/?doi=ijps.2005.851.855.

[10] EMA (European Medicines Agency).( 2015). European Union herbal monograph on *Matricaria recutita* L., flos. EMA/HMPC/55843/2011.

[11] Haile, A.A., Tsegay, B.A., Seid, A., Adnew, W., & Moges, A.(2022) A review on medicinal plants used in the management of respiratory problems in ethiopia over a twenty-year period (2000-2021).*J. Evidence-Based Complementary Altern. Med*, 2935015: 1-14. doi: 10.1155/2022/2935015

[12] Hanafy, D.M., Prenzler, P.D., Burrows, G.E., Ryan, D., Nielsen, S., El Sawi, S.A., El Alfy, T.S., Abdelrahman, E.H., & Obied, H.K. (2017). Biophenols of mints: Antioxidant, acetylcholinesterase, butyrylcholinesterase and histone deacetylase inhibition activities targeting alzheimer‘s disease treatment. *Journal of Functional Foods*, 33, 345–362. https://doi.org/10.1016/j.jff.2017.03.027.

[13] Hassan, Z. I.(2021). Effect of Mychorrizae, Nano Fertilizer and Gibberilic acid on growth and Volatil oil content of *Mentha piperita* L. Ph.D. thesis. College of Agricultural Engineering Sciences. University of Baghdad .

[14] Hassn, I.A., & Rabie, K.M. (2020). The response of tow cultivars of Basil plant to organic and Bio- Fertilization in the yield of volatile oil and some of its active compounds .*Biochem.Cell.Arch*.vol.20.No.1.pp.591-602. Doi:10.35124/bca.2020.20.1.591

[15] Nasrin, M.S., Ghasemi, S., &Shahbazi, M.S. (2022). The effect of phosphorus selenium and biological fertilizer on quantitative and qualitative characteristics of saffron (*Crocus sativus* L.). *J. Saffron Res.* 9(2): 295-279.

[16] Salehi, B., Valussi, M., Jugran, A.K., Martorell, M., Ramírez-Alarcón, K.,Sawi, S.A., El Alfy, T.S., Abdelrahman, E.H., & Obied, H.K.( 2017). *Scientific Journal of Medical Science*. 4. 413-420.

[17] Tai, Y., Ling, C., Wang, C., Wang, H., Su, L., Yang, L., & Liu, C. (2020). Analysis of terpenoid biosynthesis pathways in German chamomile (*Matricaria recutita*) and Roman chamomile (*Chamaemelum nobile*) based on co-expression networks. Genomics, 112(2), 1055-1064. DOI: 10.1016/j.ygeno.2019.10.023. https://pubmed.ncbi.nlm.nih.gov/31706023/

[18] Urcoviche, R.C., Gazim, Z.C., Dragunski, D.C., Barcellos, F.B., & Albertona, O.( 2015). Plant growth and essential oil content of *Mentha crispa* inoculated with arbuscular mycorrhizal fungi under different levels of phosphorus. Ind. Crops. Prod. 67, 103–107,http://dx.doi.org/10.1016/j.indcrop.2015.01.016.

[19] Wang, X., Ort, D.R., &Yuan, J.S .(2015). Photosynthetic terpene hydrocarbonproduction for fuels and chemicals, *Plant biotechnology journal* . 13(2) 137-146. . doi.org/10.1111/pbi.12343

[20] Zemestani ,M ., Maryam, R., & Mohammad, A. J.(2018). Effects of chamomile tea on inflammatory markers and insulin resistance in patients with type 2 diabetes mellitus Students’ Research Committee, Faculty of Nutrition, Tabriz University of Medical Sciences. . *Trends Gen Pract*, Volume 1(3): 1-6. ISSN: 2516-823