IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A Review On Occurance, Extraction And Isolation, Chemical Nature, Characteristic Features,Uses In Pharmacy ,Medicinal And Health Benefits Of D – Limonene

[1]Jasna T J, [2]Sreeshma.K.Babu, [2]FathimathulNasrin K.A

[1]Associate Professor, [2]M.Pharm Student

[1]Department of Pharmacognosy and Phytochemistry, Nehru College of Pharmacy, Thiruvilwamala, Thrissur, Kerala, India, Pin:680 588

ABSTRACT

D-limonene, a monocyclic monoterpene, is also known as 4-isopropenyl-1-methylcyclohexene (C10H16).D-limonene can be found in the rinds of citrus fruits such as oranges, limes, and mandarins. It is likely the best-known terpene found in nature. It has several advantages but a restricted number of uses. Many healthcare providers have emphasized the potential benefits of D-limonene, claiming that it can prevent or treat different medical conditions such as gallstones, diabetes, cancer, and pneumonia. Businesses additionally utilize it to make synthetic solvents, fragrances, plant pesticides, and hand sanitizers.

This review discusses the occurrence, extraction, isolation, chemical nature, distinctive properties, pharmaceutical uses, medicinal and health benefits of d-limonene. The purpose of this study is to investigate and summarize the relevant data and evidence about D-limonene, with a focus on its therapeutic efficacy and health advantages. D-limonene is a well-known monoterpene that is commonly utilized as a scent in essential oils. It is generally known that D-limonene has remarkable biological activity.

KEYWORDS: d –limonene, occurance, extraction, medicinal and health benefits.

INTRODUCTION

Limonoids, a well-known class of highly oxygenated triterpenoid compounds, occur as secondary metabolites in the rutaceae and meliaceafamilies. The two main types of limonoids are limonoidglucosides (LGs) and limonoidaglycones. The primary limonin and nomilinaglycones that cause citrus juices to bitter and lose quality are known as limonoids. These are abounding in sweet or sour smelling citrus fruits such as lemon, cherries, basil, ginger, rosemary, and garlic. This phytochemical occurs in two optically active forms: l limonene and d limonene. D limonene is the chemical responsible for the pungent fragrance of oranges. Chemically, the limonoids are made up of a variety of furanolactone core structures. The furan ring and four six-membered rings make up the archetypal structure. Among the tetranortriterpenes are limonoids.(1)

Orange and other citrus fruit peels are used to extract the oil limonene. People have long extracted essential oils such as limonene from citrus fruits. Nowadays, limonene is a popular ingredient in household items and is widely used as a natural remedy for a variety of health issues. Limonene is a popular ingredient used in cleaning products, meals, cosmetics, and natural insect repellents. For example, it imparts a lemony flavor to foods such as sodas, candies, and desserts.Limoneneis extracted using the hydrodistillation method, which includes soaking fruit peels in water and heating them until the volatile molecules are released by steam, condensing, and separating [(2)].

Lemon limonene is often used as a botanical insecticide due to its potent smell. It is an active ingredient in numerous pesticide formulations, including eco-friendly insect repellents.This chemical is also present in laundry detergents, air fresheners, soaps, shampoos, lotions, and perfumes. Furthermore, limonene can be obtained in liquid and pill form as concentrated supplements. These are commonly touted as providing health benefits, including cancer therapy. When given orally in 21-day cycles, one kind of limonene (D-limonene) appears to accumulate in tumors in patients with advanced cancer. Although the tumors' high limonene level may slow cancer progression, it is not clear how this may impact the patient's chances of survival. Prevention of Cancer, Reduced weight Pneumonia and other similar circumstances.[(3)]

OCCURRENCE

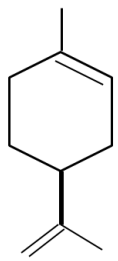
Natural occurance;

d-limonene is one of the most common terpenes in nature , occurring in citrus and a wide variety of any other plants species. It is a major constituent of oil of citrus rind, dill oil, oil of cumin, neroli, bergamot and caraway[(4)].

Extraction of d limonene

Take Orange peels (citrus Peels) and heated in oven for 2 hours at 40-50 degree celcius . Heat treatment for removal of moisture out of the seeds. Solvents like Ethanol, Methanol, n-hexane and mixed solvent system were utilized for d-limonene extraction. Soxhlet Extractor used for extraction of D-limonene from Orange Peels with n-hexane/ethanol solvent. Extraction done which the solvent by using Soxhlet extraction apparatus. For separation of solvent from citrus peels. We can use water bath as heating media/Simple Distillation. D-limonene allowed to cool in a desiccator before being weighed. The extracted D-limonene kept in dark glass bottle and kept for analysis. Find various properties and % Recovery or yield of oil.[(5)]

CHEMICAL PROPERTIES OF D LIMONENE[(6)]



Structure of d-limonene

Chemical properties of d-limonene

CHEMICAL NATURE	D LIMONENE
MOLECULAR FORMULA	$C_{10}H_{16}$
MOLECULAR WEIGHT	136.24 g/mol.
MELTING POINT	-142.4°F (-97.4°C)
BOILING POINT	348–349°F (176°C)
DENSITY	0.8411 g/cm3 at 20 °C/4 °C
SOLUBILITY	13.8 milligrams per liter at 25°C in water
REFRACTIVE INDEX	1.461 - 1.481 at 20°C

USES

For almost 50 years, perfumes (0.005% and 1%), soaps, drinks, food, and household cleaning goods have all include limonene as a taste and aroma ingredient. Additionally, it goes into making nonalcoholic drinks(31ppm), ice-cream(68ppm), candies (49ppm),baked products(120ppm),puddings (48-400 ppm),sweets, and chewing gum (2300 ppm).It has been used as a solvent and cleaner in the petroleum industry, as an additive to boost the penetration of active ingredients in transdermal medicines, as a degreasing agent prior to industrial product lacquering (30%), and in the electronic industry for cleaning printed circuits (50-100%) and print cylinders in printing operations. Moreover well-known include insecticide, dog and cat repellant, and pesticide.(7)

HEALTH BENEFITS

Studies have been conducted on the possible anti-inflammatory,antioxidant, anticancer, and cardiac disease preventing effects of limonene.

Nevertheless, the majority of studies have been carried either on animals or in test tubes , making it challenging to completely comprehend the function of limonene in maintaining human health and preventing disease.

ANTIOXIDANTS AND ANTI-INFLAMMATORY

- Certain research have demonstrated that limonene reduces inflammation.
- It has been demonstrated that limonene lowers inflammatory markers linked to osteoarthritis, a chronic inflammatory disease.
- In a test-tubeinvestigation, limonene was found to decrease the generation of nitric oxide in human cartilage cells. One signaling molecule that is important in inflammatory pathways is nitric oxide.
- Limonene treatment dramatically reduced colon damage and inflammation as well as common inflammatory markers.
- Additionally,limonene has shown antioxidant properties.

- limonene may prevent leukemia cells' free radicals from causing inflammation and cellular damage, which would typically lead to disease.(8)

ANTICANCER PROPERTIES

- Consuming citrus fruit peel—the primary dietary source of limonene—reduced the risk of skin cancer in a population research as compared to individuals who merely ate citrus fruits or their juices.
- Ingesting 2 grams of limonene daily for 2–6 weeks significantly reduced the expression of breast tumor cells in 43 women who had just been diagnosed with breast cancer.
- Limonene supplements prevented oxidative stress and inflammation, which in turn stopped the growth of skin cancers.
- Limonene may combat many cancers, such as breast cancer.[9]

IMPROVE CARDIAC HEALTH

- Heart disease continues to be the primary cause of mortality in the US, taking the lives of about one in four people.
- By lowering risk factors such high blood sugar, triglyceride, and cholesterol, limonene may help lessen your chance of heart disease.
- In a particular investigation, mice administered 0.27 grams of limonene per pound of body weight (0.6 grams/kg) demonstrated lower levels of fasting blood sugar, triglycerides, LDL (bad) cholesterol, and liver fat formation as compared to a control group .[10]

HANDLING OF DIGESTIVE DISCOMFORT

- When food does not pass through the digestive tract at the right rate, it is called gastric reflux. This usually happens as a result of bile backing up into the stomach. D-limonene pills used daily have been shown in several studies to help relieve upset stomach.[11]

BOWEL MOTILITY

- Regular bowel movements can also be maintained with the aid of D-limonene. It is particularly beneficial in cases where intestinal infections are brought on by the fungus Candida albicans, which is the cause of slow-moving bowels.[12]

GALLSTONE MANAGEMENT

- D-limonene is helpful in controlling gallstones because it may help breakdown cholesterol. Additionally, this impact may support healthy lymphatic system circulation and blood cholesterol levels.[13]

WEIGHT MANAGEMENT:

- Since D-limonene has a slight appetite suppressant effect, it might assist with weight management. For this purpose, it is especially helpful if your blood sugar levels are not optimal.[14]

CONCLUSION

D-Limonene, a naturally occurring chemical found in citrus fruits, has a wide range of therapeutic characteristics. It is easily extracted and isolated using steam distillation and chromatography, and its chemical stability and solubility make it suitable for a variety of therapeutic uses. Research shows that it has antibacterial, antioxidant, anti-inflammatory, and anticancer qualities, making it a useful treatment for digestive disorders, anxiety, and cancer. Additionally, D-Limonene promotes immunological function, antioxidant activity, and cardiovascular health. Pharmaceutical applications include wound healing, oral care,

chemotherapy, and digestive aids. Future research objectives include looking into its potential in neurodegenerative illnesses, synergistic effects, and tailored delivery systems. D-Limonene's natural abundance and broad pharmacological properties make it a promising candidate for use in pharmacy, medicine, and health supplements, but further research is needed to fully realize it's potential.

REFERENCE

[1]K R, S S, Bhaskar S A V, S M V, SeshaMrN. Extraction of Essential Oil D-Limonene from Sweet Orange Peels by Simple Distillation. IOSR Journal of Applied Chemistry. 2016 Sep;09(09):16–7.

[2]Anandakumar P, Kamaraj S, Vanitha MK. D-limonene: A multifunctional compound with potent therapeutic effects. Journal of Food Biochemistry. 2020 Dec;45(1).

[3] Roy A, Saraf S. Limonoids: Overview of Significant Bioactive Triterpenes Distributed in Plants Kingdom. Biological & Pharmaceutical Bulletin. 2006;29(2):191–201.

[4]Scheline RR. Handbook of Mammalian Metabolism of Plant Compounds (1991). CRC Press; 2017.

[5]Working I, For A. Some naturally occurring substances : food items and constituents, heterocyclic aromatic amines and mycotoxins. Lyon: World Health Organization, International Agency For Research On Cancer; 1993

[6]Limonene - an overview | ScienceDirect Topics [Internet]. Sciencedirect.com. 2010. Available from: https://www.sciencedirect.com/topics/chemistry/limonene

[7]Gupta A, Jeyakumar E, Lawrence R. Journey of Limonene as an Antimicrobial Agent. Journal of Pure and Applied Microbiology. 2021 Jun 22;15(3):1094–110

[8]Yu L, Yan J, Sun Z. D-limonene exhibits anti-inflammatory and antioxidant properties in an ulcerative colitis rat model via regulation of iNOS, COX-2, PGE2 and ERK signaling pathways. Molecular Medicine Reports [Internet]. 2017 Apr 1;15(4):2339–46. Available from: https://pubmed.ncbi.nlm.nih.gov/28260017/

[9]Araújo-Filho HG de, dos Santos JF, Carvalho MTB, Picot L, Fruitier-Arnaudin I, Groult H, et al. Anticancer activity of limonene: A systematic review of target signaling pathways. Phytotherapy Research. 2021 Apr 17;35(9):4957–70.

[10]Pagidipati NJ, Gaziano TA. Estimating Deaths From Cardiovascular Disease: A Review of Global Methodologies of Mortality Measurement. Circulation [Internet]. 2013 Feb 12;127(6):749–56. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3712514/

[11]Rodríguez A, Andrés VS, Cervera M, Redondo A, Alquézar B, Shimada T, et al. The monoterpene limonene in orange peels attracts pests and microorganisms. Plant Signaling & Behavior [Internet]. 2011 Nov;6(11):1820–3. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3329358/

[12]Cholke S, Tambe S, Shermale S, Dabhade K, Nibe RL. Extraction and Separation of D-limonene From Orange (Citrus) Peels. JOURNAL OF TECHNICAL EDUCATION.:300.

[13]Scheline RR. Handbook of Mammalian Metabolism of Plant Compounds (1991). CRC Press; 2017.

[14] Limonene - an overview | ScienceDirect Topics [Internet]. Sciencedirect.com. 2010. Available from: https://www.sciencedirect.com/topics/chemistry/limonene