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Review Article

Pharmacology and Application of Camphor

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ABSTRACT

Camphor ($C_{10}H_{16}O$), a white crystalline solid with enantiomeric R and S forms, is a terpene historically obtained from the heartwood of the Cinnamomum camphora tree by steam distillation. It has a long history of application in traditional medicine across cultures for its characteristic cooling sensation and diverse array of pharmacological activities. Camphor has been known to have antipyretic, antibacterial, antifungal, antiviral, antioxidant, antiinflammatory, and antitumor activities, and serves as a skin penetration enhancer too. Camphor has been widely used to treat minor conditions like pain, irritation, inflammation, congestion, and infections. In recent studies, camphor has shown promising uses outside what has traditionally been known. Some of the Cinnamomum camphora components have proven to be anti-mutagenic against other human cancer cell lines, differentiating between cancer and healthy cells without harming the latter. It is also of increasing interest for the possible treatment of severe ailments such as cancer and diabetes. The compound is biosynthetically similar to alpha-pinene, which is a product of catalytic reactions, indicating its chemical importance even further. This review of the literature is intended to investigate the past and present applications of camphor, paying particular attention to its use in general health cures and future medical studies. In addition, it suggests further scientific examination of camphor's impacts on neurodegenerative and memory disorders, hopefully to unleash novel therapeutic uses. With this review, we hope to bridge ancient knowledge with contemporary pharmacology and stimulate additional studies into this useful natural compound.

INTRODUCTION

Camphor is a white, crystalline material characterized by its pungent, characteristic odor and acrid taste. It's classically obtained from wood

of the camphor laurel tree (Cinnamomum camphora) and related trees in the laurel family. Camphor laurel is an evergreen, fragrant tree native to places such as China, India, Mongolia, Japan, and Taiwan. One specific camphor tree is

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also cultivated in the southeastern United States, particularly in Florida.[1,2] Camphor has many pharmaceutical applications. It is used widely as a local analgesic (to alleviate pain on the skin), antiseptic, antispasmodic (to alleviate muscle spasms), anti-itch (anti-pruritic), anti-inflammatory, and anti-infective agent. It is also employed as a rubefacient (to stimulate blood flow to the area), contraceptive, mild expectorant (to aid mucus clearance), nasal decongestant, and cough suppressant [3,4] The leaf of the camphor tree (*Cinnamomum camphora*) has camphor as its primary constituent. It also contains a number of other natural compounds like cineole, linalool, eugenol, limonene, saffrole, α -pinene, β -pinene, β -myrcene, α -humulene, p-cymene, and nerolidol.[5] Ribosome-inactivating proteins (RIPs) show tremendous potential in drug and agricultural biotechnology development, owing to their virulence, cancer cell toxicity, insecticidal properties, and fungal pathogen toxicity against plants.[6] The most frequently encountered camphor poisonings have involved preparations such as camphorated oil (20% camphor in cottonseed oil) and camphor spirits (camphor 10% in alcohol or isopropyl alcohol). A number of these were due to the fact that individuals ingested camphorated oil with the mistaken belief that it was castor oil.[7,8] The precise mechanisms by which camphor leads to toxicity are not yet fully known. Nevertheless, once the person has ingested it, camphor is absorbed rapidly through the gut, and quantifiable amounts can be detected in the blood within minutes.[9,10] Between 5 to 15 minutes after the exposure, individuals will start

showing eye, nose, and throat irritation, with additional effects such as nausea, vomiting, and abdominal pain. Generalized tonic-clonic seizures are one of the first and most severe manifestations of poisoning and can occur shortly after ingestion of the substance.[11,12] Even if lots of camphor is used on the skin, it's highly unlikely that it will seriously poison someone like swallowing lots of it will.[13,14,15] Camphor appears to cross the placenta readily. Both normal delivery and death of the fetus have been reported following poisoning of the mother by camphor during the latter part of pregnancy [16,17,18]



Fig 1: Camphor

Camphor Containing Product

Table 1 indicates some of the common U.S. products that have camphor. They are normally contained in pharmaceutical products such as creams, ointments, and rubs. The percentages of camphor in these products typically range from 0.5% to 10.8% depending on the company and intended use.[19,20]

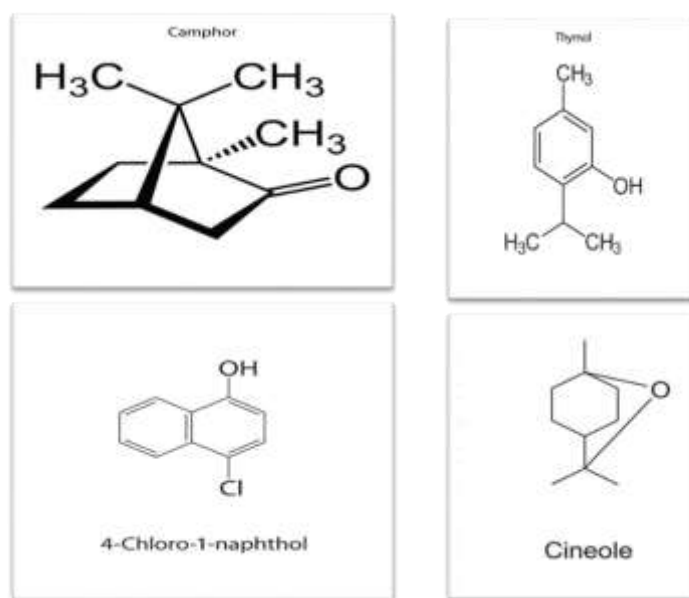
Product	Camphor concentration		Other ingredients
Air Saloupas Topical Spray	3%	30 mg/mL	menthol 3.2% methyl salicylate 1.75%
Banalg	2%	20 mg/cm ³	menthol 1% methyl salicylate 4.9%
Boyer Muscle and Joint Cream	4%	40 mg/cm ³	menthol 10% methyl salicylate 30%
BenGay Ultra Strength Cream	4%	40 mg/cm ³	menthol 10% methyl salicylate 30%
Campho-Phenique Cold Sore Treatment with Drying Action	10.8%	108 mg/mL	phenol 4.7%
Campho-Phenique Pain Relieving Antiseptic Gel	10.8%	108 mg/cm ³	phenol 4.7%
Campho-Phenique Pain Relieving Antiseptic Liquid	10.8%	108 mg/mL	phenol 4.7%
Camphor Ice Skin Balm	2.5%	25 mg/cm ³	
Camphor-Phenol Oral Rinse	10.8%	108 mg/mL	phenol 4.7%
Flexall 454 Ultra Plus Muscle Rub Ultra Strength Gel	4%	40 mg/cm ³	menthol 10% methyl salicylate 30%
Flexall 454 Ultra Plus Pain Relieving Rub Ultra Cream	4%	40 mg/cm ³	menthol 10% methyl salicylate 30%
Heet Liniment	3.6%	36 mg/mL	capsicum 0.025% methyl salicylate 15%
Menthol Chest Rub – Schuck's	4.7%	47 mg/cm ³	menthol 2.6% eucalyptus oil 1.2%
Mentholatum	9%	90 mg/cm ³	menthol 1.35%
Mentholatum Chest Rub for Kids	4.7%	47 mg/cm ³	menthol 2.6% eucalyptus Oil 1.2%
Mentholatum Decongestant Analgesic	9%	90 mg/cm ³	menthol 1.3%
Nuevo Cream	4.8%	48 mg/cm ³	phenol 2.6%
Finalgesic Gold Topical Liquid	3.1%	31 mg/mL	menthol 1.25% methyl salicylate 55.01%
Saloupas Transdermal Patch	26 mg		menthol 120 mg methyl salicylate 132 mg
Sama Lotion	0.5%	5 mg/mL	menthol 0.5%
TheraFlu Vapor Stick	4.8%	48 mg/cm ³	menthol 2.6%
Vicks VapoRub Cream	5.2%	52 mg/cm ³	eucalyptus oil 1.2%, menthol 2.6%
Vicks VapoRub Ointment	4.8%	48 mg/cm ³	eucalyptus oil 1.2%, menthol 2.6%
Vicks VapoSteam	6.2%	62 mg/mL	

CHEMICAL COMPOSITION:

Among the chemical substances extracted from *Cinnamomum camphora*, otherwise known as the camphor tree, are menthol, thymol, salicylic acid, phenol, and naphthol. These occur in small, broken quantities. The primary active components naturally found in the plant are camphor, camphorol, cineole, camphene, dipentene, terpineol, candinene, safrole, camphorace, laurilitsine, and reticuline. There is also a substance called cinnamaldehyde—whose cause is the characteristic, pungent aroma of cinnamon—that occurs in bark on the tree. [21] The entire *Cinnamomum camphora* plant, also referred to as the camphor tree, is full of different natural compounds. Some of these include lignans such as secoisolariciresinol dimethyl ether and kusunokiol, while others are substances such as camphor, safrole, linalool, eugenol, and terpineol.

Volatile oils also make up a large portion of the plant, giving it a distinct smell.[21] In the volatile oil composition of young leaves, scientists detected a total of 11 monoterpenes, 5 sesquiterpenes, and 4 oxyterpenes. Of the important oxyterpenes were (+)-borneol, which was most dominant at 66.8%, followed by 1,8-cineole (4.1%), camphor (0.8%), and α -terpineol (0.4%).

Oxyterpenes comprised the largest portion of oil composition, representing 72.2%. Monoterpenes represented 24.4%, and notable compounds include α -camphene, β pinene, and β -myrcene.[22] The main constituents identified in the leaf essential oil (EOC) were linalool (26.6%), 1,8-cineole (16.8%), α -terpineol (8.7%), isoborneol (8.1%), β phellandrene (5.1%), and camphor (5.0%).[23]



PHARMACOLOGICAL ACTION :

Antimicrobial Activity : *C. camphora* has been used classically as an antiseptic, possibly due to the fact that its essential oil possesses a strong antimicrobial activity. Research has indicated that it is capable of combating a broad spectrum of dangerous pathogens[24,25,26,27] People around the world are increasingly turning to plant-based chemicals for their antibacterial properties. For centuries, plants have been a valuable natural resource for supporting and protecting human Health[28] The health of people is currently seriously threatened by the abuse and overuse of antibiotics. The rate at which antibiotic-resistant bacteria are spreading is even more concerning.[29]

Antitumor Activity : Natural substances like polyphenols and flavonoids, which have been linked to anticancer effects, are found in extracts from *Cinnamomum* plants, including the essential oil of *C. longepaniculatum*. This study investigated the effects of ethanol extracts from *C. camphora* leaves on three different human cancer cell types: liver cancer (HepG2 cells), lung cancer (95-D cells), and oral epidermal carcinoma (KB cells).[30]

Anti-inflammatory : It functions by preventing the body from producing certain inflammatory molecules that are involved in inflammation and the immune response, such as $\text{TNF-}\alpha$, $\text{IL-1}\beta$, and IL-6 . [31] aids in preventing the breakdown of red blood cells when exposed to heat or a diluted (hypotonic) solution.[32]

Insecticidal and Acaricidal Activities : Pesticides based on essential oils are effective against a variety of pests. They are an excellent choice because they are readily available, composed of renewable resources, and decompose rapidly in the environment, reducing the likelihood of long-term damage.[33] The ability to kill *Tetranychus cinnabarinus*. [34]

Anti-oxidative Activity : As CCEO concentration rises, so does its antioxidant capacity. According to studies, CCEO increases the activity of antioxidant enzymes, which aids in lowering the body's levels of dangerous reactive oxygen species, or free radicals. Furthermore, greater amounts of C [35]

APPLICATION :

For centuries, both traditional and modern medicine have utilised camphor, a natural

substance. Camphor has long been used to help people with cold related chest congestion. Additionally, it has been used to treat rheumatism, sprains, bronchitis, asthma, indigestion, and muscle pain in addition to reducing inflammation.[36] In radiotherapy, camphor might also have radio sensitizing properties. It was discovered that administering camphor prior to radiation therapy decreased the growth of tumours.[37] Because ribosome-inactivating proteins (RIPs) are highly toxic to viruses, cancer cells, insects, and plant fungal pathogens, they hold great promise for use in drug development and crop improvement technologies.[38] A surprising application for camphor is in the synthesis of carbon nanotubes (CNTs). The fibres that make up these nanotubes are incredibly light and strong; they are basically carbon sheets that are one atom thick and rolled into tiny tubes. The discovery and development of carbon nanotubes (CNTs) has been a significant advancement in recent years, with exciting new opportunities in industry and medicine.[39] An inexpensive and simple-to-grow plantbased hydrocarbon, camphor is a dependable substitute for petroleum products, which frequently have supply problems. Camphor is therefore a particularly good source of carbon for the synthesis of carbon nanotubes. It provides a method for producing nanotubes with high yield, superior purity, and potent performance, making it a wise and environmentally friendly choice for the future.[40]

CONCLUSION

Antimicrobial, antitumor, and antioxidant compounds have been studied pharmacologically, showing their large therapeutic potential in a range of medical applications. These compounds offer promising alternatives in the event of increased antibiotic resistance since they possess broad-spectrum antimicrobial activity against a host of

bacterial, viral, and fungal pathogens. Their potential as candidates for cancer therapy is also validated by their antitumor activities, which are mediated by mechanisms such as cell cycle arrest, induction of apoptosis, and angiogenesis inhibition. In addition, their antioxidant activity enhances their defense effects in various chronic and degenerative diseases and decreases oxidative stress.

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