

Menthol as a Pain Reliever and Halitosis Treatment

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Abstract:

Background: Menthol is a chemical compound from nature, that is widely used as a basic ingredient in the pharmaceutical and food industries. Menthol is produced in the form of crystals or granules. DL-Menthol and L-Menthol are widely used as flavoring, disinfectant and cooling compounds in confectionery products, chewing gum, toothpaste, cosmetics, cigarettes and flu ointments and medicines.

Materials and Methods: This is a review article.

Key Word: Cooling; Halitosis; Menthol; Pain Reliever; Peppermint.

I. INTRODUCTION

Menthol is a cyclic monoterpene alcohol that can be used for various products. In medicinal applications, menthol can act as a skin absorption agent, local anesthetic, topical analgesic, antipyretic, and gastric sedative¹.

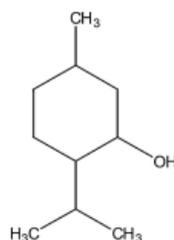


Figure 1. Structure of menthol².

Menthol is the main bioactive agent of Peppermint and is slightly polar because menthol is a monoterpene that has a phenolic group. Menthol is a waxy, crystalline, white substance that is solid at room temperature and has a minty, sweet, and refreshing smell³. Menthol (2-Isopropyl-5-methylcyclohexanol) is a naturally occurring organic compound that has a wide range of biological responses. Menthol produces a sensation of coolness, without a decrease in temperature, by activating cold sensory pathways to the thalamus and somatosensory cortex. Menthol applications come in several forms. For example, menthol can be applied externally to the skin via a cream, gel, spray, or solution, whereas internal application is achieved by consuming a drink or mouthwash⁴.



Figure 2. Peppermint⁵

Menthol Properties

Menthol can chemically trigger cold sensitive receptors on the skin. Menthol is responsible for the cooling sensation caused when inhaled, eaten, or applied to the skin. Menthol does not cause an actual drop in temperature. Menthol has a white or colorless crystalline form with a melting point of 41-44°C, and will solidify when stored at room temperature (25°C) with a density of 0.890 kg/dm³. Menthol is poorly soluble in water (435.5 mg/L at 25°C), and is soluble in alcohol, diethyl ether or chloroform. Menthol can absorb UV light with a wavelength of less than 290 nm⁶.

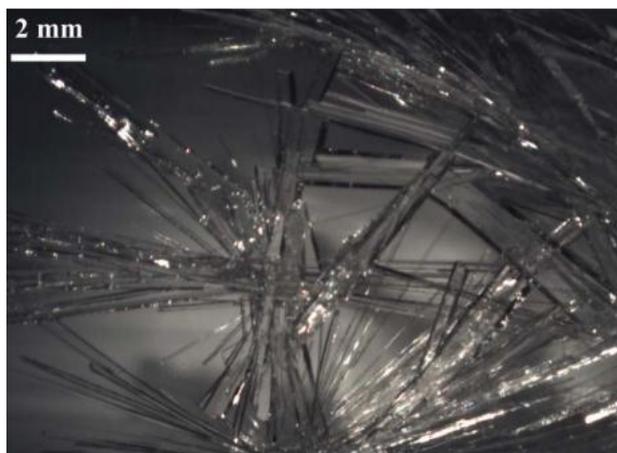


Figure 3. Crystal menthol⁷

Menthol has a molecular weight of 156.27 g/mol. The molecular formula is Molecular Formula C₁₀H₂₀O. The menthol can be identified using several instruments such as FTIR, HPLC, and NMR. The identification of menthol isolated from *M. longifolia* leaf using FTIR showed a peak at 3362 cm⁻¹ as a hydroxyl group; peak 2855 cm⁻¹, 2924 cm⁻¹ as methyl group; peaks of 1025 cm⁻¹ and 1045 cm⁻¹ as (C-O) bond and 1368 cm⁻¹ as isopropyl group⁸.

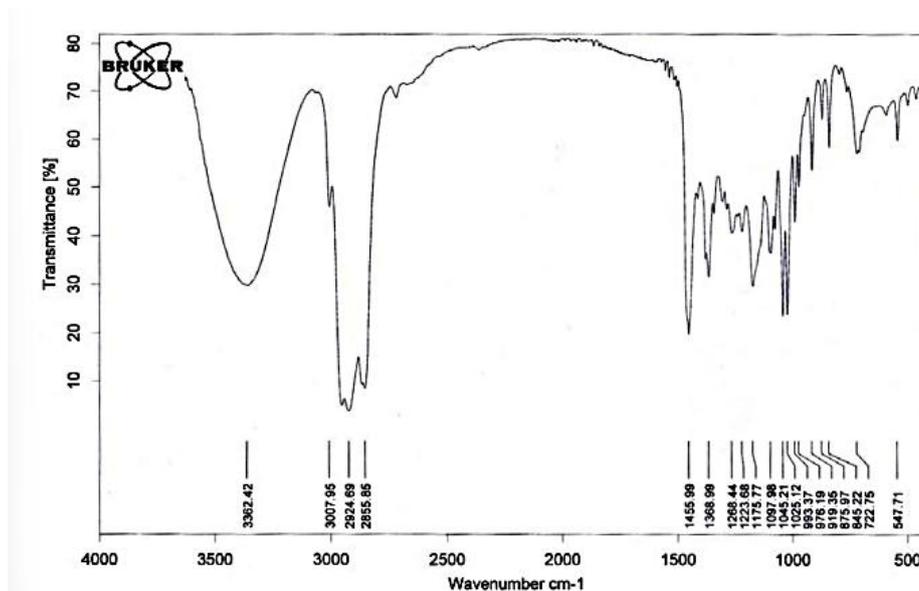


Figure 4. FTIR spectrum of menthol⁸

Identification of menthol using an HPLC instrument showed that menthol appeared at a retention time of 7-8 minutes⁹.

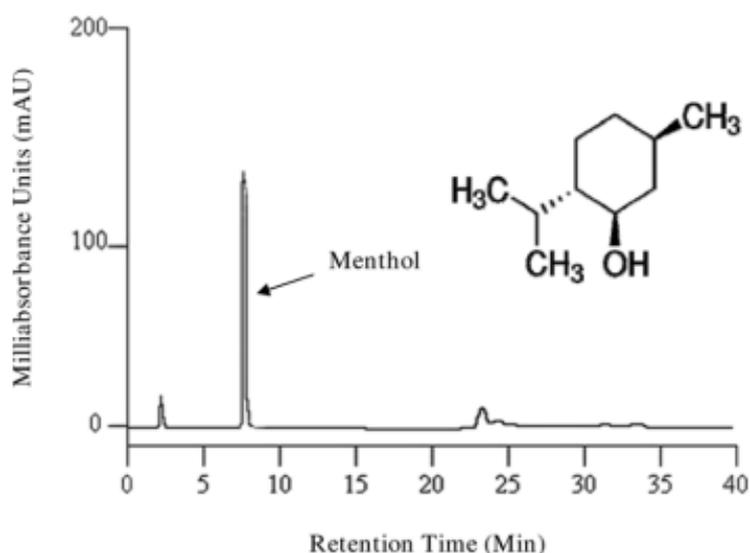


Figure 4. HPLC chromatogram of menthol⁹

Menthol as a pain reliever

Menthol as a topical will stimulate thermoreceptors, resulting in a sensation of cold or warmth, and has an anesthetic effect¹⁰. Menthol is a chemical derived from natural and semi-synthetic sources. Global use of pure menthol is estimated at more than 20,000 tonnes per year. Its benefits include various applications such as a flavoring, cooling component, and a local anesthetic in drug formulations and skin products¹¹. Menthol can be used for various products, such as medicinal applications; menthol, can act as a skin absorption agent, local anesthetic, topical analgesic, antipyretic, and gastric sedative¹.

Based on the therapeutic effect, topical products containing menthol are used in clinical treatment such as arthritis, muscle tension, back pain, and pain relief¹². However, menthol is also a commercial raw material that has been consistently used until now, especially in the pharmaceutical field. In the pharmaceutical sector, menthol is also used as an ingredient in several commercial products, such as toothpaste that uses menthol as a flavoring agent¹³.

Pain is one of the most prominent negative physiological conditions¹⁴. Pain is the result of several etiologies that need to be addressed by every doctor. Pain manifests various physiological, pathological, and others that require actions¹⁵. Pain is an uncomfortable sensory and emotional experience associated with tissue damage or potential tissue damage¹⁶. When experiencing pain, pain relief is almost always sought after, especially when suffering from persistent pain. In these situations, pain relief can be a very dominant goal¹⁷. Topical analgesics are one of the agents used in the treatment of pain¹⁸. Analgesic is one of the drugs used to reduce and eliminate pain or painkillers without losing consciousness¹⁹.

Menthol is a topical analgesic of 30-70% peppermint essential oil, effective in treating minor aches and musculoskeletal pains. Menthol can relieve pain through stimulation of TRPM8, inhibition of sodium channels, dilation of blood vessels, blocking neural calcium channels, and increasing local blood flow²⁰. The TRPM8 track is a polymodal receptor activated by many stimuli such as cold, membrane depolarization, and chemical ligands²¹. When menthol binds to the TRPM8 receptor, there will be a release of calcium ions that can reduce pain by activating endogenous opioids²².

Menthol as a halitosis treatment

Oral hygiene, which includes teeth, tongue, and salivary glands, must be considered because, with a clean mouth, we are more confident in carrying out daily activities such as eating and socializing comfortably, bad breath, canker sores, and oral infections are common problems in oral health, while more serious oral health problems are oral cancer, gingivitis, and dry mouth.²³

Bad breath can come from the oral cavity (local) called foetor ex ore or from outside the mouth (systemic) called halitosis²⁴. Bad breath can be divided into true bad breath and pseudo bad breath. True halitosis (genuine halitosis) is a condition in which problems in oral health can be diagnosed through organoleptic examination, gas chromatography, and sulfide monitoring. In contrast, false halitosis (pseudo-bad breath) is a condition in which there is no actual bad breath, but the patients believe it. If the persons still think they have bad breath after treatment, halitophobia is diagnosed²⁵. Halitosis is caused by gases called volatile sulfur compounds (VSCs) produced by bacteria in the mouth due to the metabolism of sulfur-containing

proteins. When the levels of volatile sulfur compounds and the activity of anaerobic bacteria in the mouth increase, it will cause halitosis, causing the odor of these volatile sulfur compounds to be felt by humans²⁶. The anaerobic bacteria are *Porphyromonas gingivalis*, *Treponema denticola*, *Porphyromonas endodontalis*, *Bacteroides loesche*, *Prevotella intermedia*, *Centipe da periodontii*, *Enterobacteriaceae*, *Eikenellacoordens*, and *Tannerella forsythensis*²⁷.

The peppermint flavor characteristic of menthol naturally provides a cooling or refreshing sensation because menthol interacts directly with the body's cold receptors. Toothpaste preparations added with menthol will produce a distinctive sweet-smelling aroma and give a cold or refreshing sensation so that it is used as a refresher²⁸. Essential oils are also effective in reducing halitosis. Mouthwash containing essential oils has a broad-spectrum antimicrobial effect and prevents bacterial aggregation. The mechanisms include bacterial cell destruction, inhibition of bacterial enzymes, and endotoxin extraction from Gram-negative bacteria. Clinical studies have concluded that essential oils are effective in reducing plaque, gingivitis, and halitosis due to their bactericidal properties²⁹.

Side effects

The side effect of using topical menthol is that it will feel hot on the skin area that is applied³⁰. The side effect of topical analgesics is a burning or stinging sensation in the applied area³¹.

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