

# Volatile constituents of food, spices and plants as aromatherapy for prevention and treatment of cancer

## Abstract

Aromatherapy is a part of CAM that includes the therapeutic use of essential oils from plants and their parts like flowers, leaves, roots that are used for the improvement of physical, emotional and spiritual well-being. Cancer patients have started a new resurgence in essential oils. Through aromatherapy, many cancer patients have found relief from the dire effects of chemotherapy and those caused by their illness. Aromatherapy is used by cancer patients primarily as supportive care for general well-being. This mini review will highlight on the role of essential oils and their use as aromatherapy in the prevention and treatment of cancer.

**Keywords:** cancer, essential oils, aromatherapy, food industry, complementary

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## Introduction

Food industry produces large volumes of agri-horticultural waste such as peels that originates from fruits like citrus, pineapple, mango, banana and vegetables some of them are good sources of essential oils. The essential oils have extensively been used as a natural therapy for almost every ailment. Essential oils are unstable liquid constituents extracted from aromatic plant material by steam distillation or mechanical expression. The oils that are made with the help of chemical solvents are not deliberated as real essential oils. They are most popularly used for their pleasant smell but studies have shown that up to 74.8% of people in European countries use complementary and alternative medicine (CAM) on a consistent basis including in the treatment and prevention of cancer. Aromatherapy is a part of CAM that includes the beneficial use of essential oils from floras and their parts like flowers, leaves, roots that are used for the enhancement of physical, emotive and mystical well-being. Cancer patients have started a new renaissance in essential oils. Through aromatherapy, many cancer patients have found relief from the awful effects of chemotherapy and those initiated by their disease. Aromatherapy is used by cancer patients primarily as supportive care for overall well-being. It is also used with other complimentary treatments such as massage and acupuncture and also with other usual treatments for symptom management. The special effects of aromatherapy are hypothesized to result from the binding of essential oil to receptors thereby impacting the brain's emotional center. Topical application of aromatic oils may exercise antibacterial, anti-inflammatory, and analgesic effects. Studies have shown calming and energizing effects of specific essential oils as well as optimistic effects on conduct and the immune system. Further, imaging studies support the impact of aromas on the emotive pathways.<sup>1</sup>

Most cancer chemotherapy treatments use extremely cytotoxic medications that aim multiplying cell populations. The non-discriminatory nature of these drugs results in severe side effects in normal cells with a high proliferative index, such as those of the gastrointestinal tract and bone marrow, thus restraining the operative dosage of anticancer drug that can be administered. The diverse therapeutic potential of essential oils has attracted the investigators to check them for anticancer activity, taking advantage of the fact

that their mechanism of action is unrelated to that of the classic cytotoxic chemotherapeutic agents. Initial studies had indicated that essential oil constituents, especially mono-terpenes, have multiple pharmacological effects on mevalonate metabolism which could be responsible for the tumor suppressive activity of terpenes.<sup>2</sup>

Clinical trials have examined the effect of aromatherapy primarily in dealing of stress and nervousness in patients with serious sicknesses including cancer. However, aromatherapy produces are not question to authorization by the US-Food and Drug Administration (FDA) unless there is an assertion for management of exact diseases.

## Aromatherapy for cancer prevention

Essential oils that are most effective on various types of cancer (breast, skin, cervical, prostate) as aromatherapy include sandalwood, balsam fir, thyme, hyssop, tsuga, chamomile, rosemary, oregano, lemongrass, orange and frankincense. Essential oils function naturally by boosting the immune system for most types of cancer though immune system stimulation is not so effective for leukemia or non-Hodgkin's lymphoma.

The conventional therapies used for cancer are chemotherapy, surgery and radiation. As the radiations are known to harshly damage the skin and other vital organs so the use of essential oils in combination with proper nutrition internally can help lessen this injury. Topical application of essential oils of sandalwood, hyssop, peppermint or frankincense after dilution with suitable carrier oil on the affected area may help to relieve the symptoms. Neuritis is another common side effect of radiation and can be cured with melrose, lavender or nutmeg essential oils. About 2-4drops mixed with carrier oil can be directly applied 3-5times a day that can relieve pain. These oils can also be used with a cold poultice on affected areas 2-3times a day. Likewise, chemotherapy breaks down worthy white blood cells while destroying cancer cells. Cypress oil can help remake white blood cells and can be applied directly to skin, inhaled from the bottle or a diffuser or can also be taken orally. Stomach upset and nausea are the common side effects of both of these treatments and can be relieved by using ginger, peppermint or nutmeg oil. These oils may also be used with a warm poultice over stomach as needed or can be inhaled directly from bottle.<sup>3</sup>

## Mode of action of aromatherapy

Natural essential oil components play an important role in aromatherapy for cancer prevention and treatment. The major active ingredients present in them are monoterpenes, sesquiterpenes, oxygenated monoterpenes, oxygenated sesquiterpenes and phenolics are the notable ones among others. The chemo-preventive properties of these oils is due to their different mode of actions including antioxidant, anti-mutagenic and anti-proliferative, enhancement of immune function and surveillance, enzyme induction and enhancing detoxification, modulation of multidrug resistance and synergistic mechanism of volatile constituents.

Aromatherapy exerts maximum of their pharmacological effects through the blood supply to the brain. They also have an indirect effect through the olfactory nerve pathways in the brain. The oil fragrances are absorbed through blood circulation and nerve pathways from the sinuses into the brain. There are many ways that essential oils can support the healing of cancer. Some essential oils act directly on cancer cells, prevent growth and promote cancer death. Other essential oils help with anxiety relief and emotive care. Investigators studied mint, ginger, lemon, grapefruit, jasmine, lavender, chamomile, thyme, rose, and cinnamon essential oils to check their impact on human cancer cell lines *in vitro* and found that overall, the higher the doses of essential oil, the more cancer cells were destroyed. At a concentration of 0.21%, all essential oils that were tested demonstrated a strong cytotoxicity (cell-killing ability) on prostate cancer cells. Similarly, all the essential oils except for mint elicited apoptosis (cancer cell death) in lung cancer cells. In breast cancer cells, it was found that out of six essential oils only four exhibited anti-cancerous properties.<sup>2</sup>

Some of the important essential oils effective against cancer are discussed below.

### *Thymus vulgaris* (Thyme) essential oil

*Thymus vulgaris* is an evergreen herb used for both cooking and medicine. The ancient Egyptians used it for preserving, and Greeks used it in saunas and for incense. During the Medieval times in Europe, individuals preserved thyme under their cushions to ward off dreams. Research has shown that thyme essential oil exhibits strong cytotoxicity toward breast, lung and prostate cancer cells. Thyme contains an active compound named 'thymol' that has been shown to trigger mechanisms that destroy cancer cells. It has been found that thyme may be a promising entrant in the development of unique healing agent for breast cancer treatment.

Though, thyme oil should not be used directly on the skin without being diluted with carrier oils of olive, sesame or almond. Before its application, it should be tested on a small patch of skin to ensure for an allergic reaction. It is not for internal use as it can cause nausea, dizziness, vomiting, diarrhea and muscle problems. Moreover, it should be avoided by pregnant women and patients with high blood pressure. For its topical application, around three drops of thyme oil is mixed with two teaspoons of sesame oil and applied into the affected area. It can also be used as an aromatic or the fragrance can be inhaled from the bottle.<sup>4</sup>

### *Rosmarinus officinalis* (Rosemary) essential oil

*Rosmarinus officinalis* is an aromatic evergreen shrub used for flavoring in cooking, pest control, gardening, and as a perfume in

toiletary products. The therapeutic effect is due to the presence of a number of potent phytochemicals. The main constituents of the rosemary essential oil are camphor (5.0–21%), 1,8-cineole (15–55%),  $\alpha$ -pinene (9.0–26%), borneol (1.5–5.0%), camphene (2.5–12%),  $\beta$ -pinene (2.0–9.0%) and limonene (1.5–5.0%) in proportions that vary according to the vegetative stage and bioclimatic conditions.<sup>5</sup> Rosemary has antioxidant properties that help protect against free radicals that damage cell membranes, alter DNA and kill healthy cells. Current research has shown that rosemary extract possess anti-tumor properties that are effective in treatment of colon, breast, liver, stomach, skin and blood cancer. In a study it has been observed that 1% concentration of rosemary essential oil was able to disable more than 90 percent of ovarian and liver cancer cells.<sup>6</sup>

### *Origanum vulgare* (Oregano) essential oil

*Origanum vulgare* is a common cooking herb inherent to the Mediterranean region and belongs to the mint family. It possesses a number of bioactive chemical compounds, which are responsible for their strong flavour and good medicinal properties. Research has shown that these oregano bioactive constituents use signaling pathways that cause "cancer cell suicide". Oregano essential oil has also shown to be effective against prostate, breast and skin cancer. It contains carnosol that has been shown to stop the growth of colon cancer cells and cancer cell death. Oregano also demonstrates anti-inflammatory and anti-bacterial properties. Among the major components of the oil, carvacrol and thymol exhibits the highest levels of antimicrobial activity, while their biosynthetic precursor  $\gamma$ -terpinene and p-cymene were inactive.<sup>6</sup>

### *Chamaemelum nobile* (Chamomile) essential oil

*Chamaemelum nobile* is one of the most olden medicinal herbs recognized to manhood. The flower emanates in two common varieties, German chamomile and Roman chamomile. The dried flowers of chamomile contain many therapeutic chemical constituents, mainly terpenoids and flavonoids that are responsible for their medicinal properties. Chamomile preparations are normally used in treatment of many human ailments, such as hay fever, inflammation, insomnia, gastrointestinal disorders and hemorrhoids. The most frequently used form of chamomile is in form of herbal tea. Chamomile essential oil is a more effective version for concentrated therapeutic use. It is also safe to use for babies and children.

The anticancer activity of chamomile oil is due to the presence of apigenin, a bioactive constituent. It also kills breast cancer cells and inhibits cell mutation. Scientific research has revealed that medicinal chamomile extracts have slight effect on normal cells, but have a noteworthy effect in inhibiting many human cancer cell lines. This effect has been established in skin, prostate, breast and ovarian cancer. In addition to killing cancer cells, chamomile is known to be an effective antibacterial agent. It was found that chamomile was effective against the microorganism that causes acne and it took only five minutes of exposure. Chamomile oil also possesses antioxidant activity with calming benefits in aromatherapy. It is also useful in migraines, inflammation, muscle spasms, upset stomachs, fungi and parasites. In a study, the effect of chamomile oil was observed against breast, lung and prostate cancer cells and was found to be very effective. The results revealed that the effectiveness of the essential oils was connected to a higher dose and while lower dose was ineffective.<sup>6</sup>

## Frankincense essential oil

Frankincense (*Boswellia carteri*) oil was originated from Africa, India and the Middle East countries and has been used both communally and economically as an ingredient in incense and perfumes for thousands of years. It is prepared from aromatic hardened gum resins obtained by beating *Boswellia* trees. Frankincense essential oils are extracted using hydro-distillation process and contain complex chemical constituents that exhibit anti-cancer activity. The main bioactive constituent of frankincense oil is boswellic acid, a constituent known to possess anti-neoplastic properties. Researchers have indicated that frankincense contains a compound AKBA (acetyl-11-keto-beta-boswellic acid) that aims cancer cells, such as ovarian, brain, breast, colon, pancreatic, prostate and stomach cancers.

Frankincense oil has been shown for treatment of several health conditions, and is also used as folk medicine for conditions such as asthma, gastroenteritis and skin diseases. Scientific research has shown that frankincense essential oils and extracts have a strong anti-tumor activity. Frankincense oil was verified against pancreatic cancer cells and was shown to cause high levels of cancer cell mortality. The same result was reported in a separate study on bladder cancer cells. This study found that the essential oil of *B. carteri* was able to differentiate between cancerous cells and normal healthy cells, leaving the healthy cells unaffected. *Boswellia sacra* may be effective for treatment of advanced breast cancer prevention. The essential oil induces breast cancer cell-specific cytotoxicity and is a non-surgical and non-invasive treatment option for skin cancers like basal cell carcinoma. *Boswellia carteri* and *Santalum album* (sandalwood) both kill cancer in a synergistic manner and is more effective than alone. It was also shown that Frankincense oil has an ability to differentiate cancer cells from normal bladder cells and selectively suppress cancer cell viability. Frankincense oil might represent an attractive alternative intra-vesical agent for treatment of bladder cancer. It activates a series of genes and pathways that suppress the growth and induce the apoptosis of established human cancer cell lines of different tissue origins. Besides boswellic acids, frankincense essential oil-induced anti-proliferative and pro-apoptotic activities in tumour cells may result due to the presence of high-molecular-weight bioactive compounds.

The efficacy of the primary and secondary metabolites of a plant also depends on the harvesting methods employed, storage conditions and geographic locations; that can modify the chemo-types of the natural product; therefore, good agriculture practices (GAP) need to be employed. In addition, standardization of distillation procedures and identification of signature compounds will be required for quality assurance purposes. Results from preliminary clinical observations indicated that frankincense essential oil may be a feasible therapeutic agent for treatment of a range of cancers including ovarian cancer. The potential cancer-killing properties of frankincense are due to their ability to regulate cellular epigenetic machinery, which highpoints its capability to influence genes to promote healing. The other uses of Frankincense oil includes anti-inflammatory, boost immunity, fights infections, improves anxiety, heals skin and reduces acne and scarring. Frankincense is also effective in treating autoimmune diseases like bronchial asthma, Crohn's disease, rheumatoid arthritis and ulcerative colitis.<sup>6</sup>

## Beta-elemene (Ethenyl-1-methyl-2,4-bis(1-methylethenyl) cyclohexane)

Beta-elemene is a volatile terpene found in celery, mint and in numerous other herbs used in customary medicine. The refined form is generally not recommended as a dietary supplement because of their poor absorption. Though, many patients consume herbs high in beta-elemene in faith that it aids in curing cancer. Research findings indicate that beta-elemene injection may improve effectiveness of chemotherapy for the treatment of lung cancer. However, controlled trials are needed to confirm this observation.<sup>6</sup>

## Aromatherapy in patient's recovery

Aromatherapy can be either self-administered or directed by a professional. Many aroma therapists work as massage therapists, psychologists, chiropractors, or social workers. They may use the oils in their practices to benefit from relieving pain and enhancing their quality of life. Essential oils can be used individually or in combination for obtaining maximum benefits as per their own body physiology because different oils may work differently on unique individuals. For this reason, aromatherapy may take time to improve the symptoms. Once the right oils that suits one's body is found, they can be applied to the skin or inhaled. For inhalation purposes, a home diffuser can be acquired. A home diffuser employs water to humidify your home and add essential oils to the environment. A few drops of essential oils are added to a steaming pot of water or to shower each day in order to vaporize the oils and inhale them. Essential oils should not be applied directly to skin, but only after diluting them with carrier oils such as olive, sesame or coconut oil. These are all good carrier oils that can infuse up the essential oils and help body to absorb them properly. One can also make creams or ointments that contain essential oils for use on sore muscles or any areas of body that are painful. Although aromatherapy is not recommended as a substitute for medical care, it can only be suggested for the traditional use based on the wisdom of those lived in harmony with nature and recent scientific studies.<sup>7</sup>

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## Conflict of interest

The authors declare that there was no conflict of interest.

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