

# The Calming Effect of Oil on Water and its Conceptual Applications in the Treatment of Various Health Challenges

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**Abstract:** Investigation into aromatherapeutic potentials of essential oils using Benjamin Franklin calming effect model is fast gaining ground. Aromatherapy is the therapeutic application of plants' essential oils in the management and treatment of various health conditions and also for the enhancement (or improvement) of psychological and physical well-being of people. Researchers have extracted essential oils from plant species and found them potent against wide range of health disease conditions such as hypertension, oncological disorders, metabolic disorders, nephrological problems, nervous disorders etc. The widely investigated plants for aromatherapeutic properties are lavender, orange, coconut and lemon. Aromatherapy is achieved either by spraying (or aerial diffusion), direct inhalation, topical application, massaging, water immersion or rarely oral administration. Although, there has been slight rebuttals on some therapeutic claims of essential oils but the fact remains that essential oils have proven to be efficacious as an alternative medicine to a number of disease conditions. This is because there are misconceptions between fragrance and essential oil. The essence of this article was to reveal the enormous aromatherapeutic properties of plants' essential oils.

**Keywords:** Calming effect, Therapeutic Properties, Aromatherapy, Essential oils, Plant raw materials, Surface tension, Health diseases.

## 1. Introduction

Aromatherapy, a form of alternative medicine that uses plant materials, aromatic plant's oil (essential oils) and other aromatic compounds for the psychological and physical well-being is gaining momentum in medicine. Therapeutic use of essential oils is nearly 6000 years old. Its use today originated in Europe and has been practiced there since the early 1900s. The ancient Chinese, Indians, Egyptians, Greeks and Romans use essential oils in the cosmetic, perfumes and pharmaceutical industries. Essential oils are products obtained from vegetable raw materials (Berger, 2007) and are complex mixture whose composition may include volatile terpenic compounds (secondary metabolites in plants and responsible for the characteristic aroma in the fruit) (Smith et al., 2001; Masen, 2002). The concept of aromatherapy as therapeutic agent is based on three theories (or mechanisms): Firstly, that the fragrance in essential oil stimulates the nerves in the brain which sends impulses to some parts of the brain (the amygdala and hippocampus) that controls memory and emotion and such can be used as anti-psychological or anti-psychiatric agent (Perry N, 2006; Mathrani, V, 2008). Secondly, that the oil interacts with body hormones and enzymes to cause changes in blood pressure, pulses and other body functions. Thirdly, that oil fragrance stimulates the body to produce pain-fighting substances and such act as analgesic agents (Prabuseenivasan, S et al., 2006). Lipids (from Greek lipos, fat) are substances of biological origin that are soluble in organic solvents but are only sparingly soluble, if at all, in water. They form the major biological membrane alongside proteins. In 1774, an American scientist, a diplomat, philosopher, an inventor and statesman, Benjamin Franklin (1706-1790), had an amazing experience on the physical properties of lipid (e.g oil) when he discovered that oil poured on water during a turbulent storm was able to calm the storm, thus, the concept "calming effect of oil on water". He investigated the well known (at least

sailors) action of oil in calming waves and articulated his observation as thus (Franklin B, 1774).

At length being at Clapham (in London) where there is, On the common, a large pond, which I observed to be One day very rough with the wind, I fetched out a cruet of oil (probably olive oil) and dropped a little of it in the water. I saw it spread itself with surprising swiftness upon the surface. I then went to the windward side, where (the waves) begin to form, and there are oil, though not more than a teaspoon, produced an instant calm over a space several yards square which spread amazingly, and extended itself gradually till it reached the lee side, making oil that quarter of the pond, perhaps half an acre, as smooth as a looking glass

The calming effect of water by oil is a consequence of a large reduction in the water surface tension. An oily surface film has the weak intermolecular cohesion characteristic of hydrocarbons rather than the strong intermolecular attractions of water responsible for its normally large surface tension. Oil nevertheless calms only smaller waves, it does not affect large waves (Donald and Judith Voet, 1990). From experimental design, the calming effect of oil on surface waves is principally to the dissipation of wave energy caused by the Gibb's surface elasticity of the monolayer with only a secondary contribution from the reduction in surface tension (Peter Behrooz et al, 2007). John Aitken (a Scottish meteorologist) insinuated that the oil-water calming effect was not because of the reduction in the frictional force of the air on the surface but the surface tension on the water surface (Aitken J, 1917; Giles, CH, 1970). This is best explained by Lord Rayleigh (Rayleigh L, 1890).

## 2. Measurement of Monolayer Thickness

The measurement of the monolayer thickness of oil was not elucidated by Benjamin Franklin. Several scientists made attempts, the likes of Miss Agnes Pockel and Lord Rayleigh. Both Pockel and Rayleigh after their scientific findings, collaborated and published their findings in the journal of Nature (Pockel, A, 1891). Finally, Irving Langmuir (an American chemist and a Nobel Laureate), modifying Miss Pockel device, by the addition of pressure measuring device attached to a fixed barrier, the device measured the effect of various compounds on water surface tension (Langmuir, 1917). This device helped to investigate water-oil interaction, the properties of oil monolayer at the air-water interface, include the monolayer thickness and cross-sectional area of membrane lipid (Langmuir, 1917).

## 3. Extraction Methods of Essential Oil

The choice of extraction method depends on the type of plant material used. The type of extraction method used can influence the quality of the essential oil because wrongful use of extracting method can damage or alter the chemical signature of the essential oil and so care should be the watchword.

There are basically two major extraction methods for extracting essential oil from plants namely: Distillation and cold expression methods. Recently, another technique has been discovered called Supercritical carbon-dioxide extraction method. Others are: Percolation or hydrodistillation, Phytonic process, Ecuelle a pique method, Solvent extraction, Enflourage method.

### Distillation

The general principle of operation of distillation is that it converts the volatile liquid (essential oil) into a vapour and condenses the vapour back into a liquid. It requires heat and so not effective for very fragile materials. This method was introduced by Von Rechenberg and was perfected by an Arabian alchemist and physician, Ibn Sina (also known as Avicenna) and lived between 980-1037AD. There are three types of distillation namely: water, water and steam and steam extractions. All these methods have the same theoretical considerations which deals with distillation of two-phase systems. The difference lie mainly with methods of handling the materials. There are three mechanistic actions involved in distillation method namely: Hydrodiffusion, hydrolysis and decomposition by heat (thermolysis). This method is very effective but without some demerits such as, incomplete extraction of essential oils, some of the oils are susceptible to polymerization, dissolution of oxygenated components such as phenols in still water, delay in accumulation of much oil, method is slow etc.

**Water distillation:** In this method, water is the extracting solvent. This method is most often employed with plant materials as direct steam causes the flowers to clump together making it difficult for steam to pass through. Plant materials extracted by this method include rose and orange.

**Water and steam distillation:** This method is widely used in rural areas and uses steam as the extracting solvent. The steam can be generated either by satellite boiler or within the still. During this process, the water remains below the plant materials which has been placed on a grate while the steam is introduced from outside the main still (indirect steam). This method can be employed with herbs and leaf materials.

**Steam distillation:** This method is the commonly used distillation method in which steam is directed through the plant materials. The steam vaporizes the lighter chemicals contained within the plant material. The steam is then condensed through a cooling process thus generating two products: the essential oils (which contains oil-soluble molecules) and a hydrolate or hydrosol (which contains water-soluble molecules). Two products obtained from this method are rose water (a widely used hydrosols for both cosmetics and culinary purposes) and rose oil (used as therapeutic agent).

**Solvent extraction:** This method is used for plant materials that are too fragile to be distilled. This method involves the use of solvent such as petroleum ether, methanol, ethanol or hexane to extract the odoriferous lipophilic material from the plant. The solvent also extract the chlorophyll and other plant tissues resulting in the highly coloured or thick (viscous extract) called **concrete**. A concrete is a concentrated mixture of waxes, and/or fats as well as the odoriferous material from the plant. The concrete is then mixed with alcohol which serves to extract the aromatic principle of the material. The final product formed is known as an **absolute**.

**Ecuelle a pique method:** This is a more modern method of extraction. It is less laborious and intense. This is the process that involves prodding, pricking, sticking action to release the essential oils. During this process, the rind of the fruit is placed in a container having spikes that will puncture the peel while the device is rotated. The puncturing of the rind will release the essential oil that is collected in a small area below the container.

**Phytonic process:** This is one of the newest methods of extracting essential oils using non-chlorofluorocarbons. It is called florasol extraction and the oils are referred to as **Phytols**.

**Enflourage method:** This is a cold-fat extraction process that is based upon the principles that fat possesses high power of absorption particularly animal fat. The fat used must be relatively stable against rancidity. This is the oldest method of essential oil extraction and it is rarely used because of its high cost. This method involves placing the plant material on a layer of glass that is first spread with a thin layer of fat called "chassis". The volatile oil diffuses into the fat, then the fat is collected and oil is extracted from the fat using alcohol. As the alcohol evaporates, the remaining content is called absolutes.

**Supercritical carbon-dioxide method:** This is used for extracting most essential oils only that it has a high financial implication. In this method, liquid carbon-dioxide is used as the extracting solvent. In this method, liquid carbon-dioxide

is added and eliminated to produce essential oil extracts that possesses high grade chemical compound. (Bervernuti F, et al., 2001).

**Cold expression:** This is basically used for extracting essential oil from citrus fruits. It involves grating or scraping the peels of a citrus fruits to release the oils. Cold expression method does not require heating and thus the oil is not heat-altered.

**Phytochemical compositions and Therapeutic uses of some plants' essential oils:** Researchers are using the concept of calming effect in the treatment of various diseases (aromatherapy). Aromatherapy is defined as using the aroma from essential oils of substances to treat various health conditions in order to support the overall health and well-being of people. Essential oils from plant species have shown enormous significance as analgesic agent(woelk H, 2006; Habanananda T, 2004). Other therapeutic properties of essential oil includes: hypotensive agent (Hwang JH, 2005; Hur MH et al., 2007), anti-depressant agent (Lee, JT et al., 2006), anti-cancer agent (Graham PH et al., 2003; Fellowes, D et al., 2004) anxiolytic agent (Setezer,WN, 2009), anti-parasitic agent (Moon T, et al, 2006), anti-microbial agent, episiotomic agent (Vakilan K et al., 2011) etc.

**Lavender oil:** *The lavender is a native plant of the mediterranean.* It is also found in southern Europe, Australia and United State. It grows in sunny and stony environment. Lavender is a heavily branched short shrub that grows to a height of roughly 60cm. It has broad root-like leafy, green shoot, silvery down covers and gray green narrow leaves which are oblong and tapered attached directly at the base and curled spirally. There are three species of lavender: *Lavandula angustifolia*, *Lavandula latifolia* and *Lavandular officinalis*.

**Chemical component:** Lavender oil contain a primay active organic compounds such as linalool(a natural terpene alcohol) and linalyl acetate (a phytochemical that is an acetate ester of the first, linalool) (Shirley Price, 1993)

**Therapeutic uses:** Lavender's therapeutic uses was first documented scientifically by a French scientist Rene Maurice Gaftefose (1881-1950), when he applied lavender'oil on his burnt hand which he sustained accidentally in the laboratory and discovered that it became healed and promoted skin regeneration and so invented the word aromatheraphy. Rene is the father of aromatheraphy. Some of the therapeutic uses of lavender oil are: as eminenagogue (promotes menstruation), anti-inflammatory agent, psoriasis, insomnia, nervous disorder, improves mental accuracy and concentration, reduces depression, and improves cognitive performance (Diego et al., 1998), Reduces mental stress and increase alertness (Motomura et al.,2001), analgesic agent in postoperative pain(Kim, JT et al., 2006), reduces autism(a neurology disorder in children and adults)(Williams TI, 2006).

**Orange oil:** Orange (*Citrus sinensis*) was brought to the mediterranean from Asia(China) by the Saracens. It is of the Rutaceae family. The use of orange in aromatherapy comes

from Sicily, Isreal, Spain, and United State. They are rich in vitamin A, B and C, flavonoid and minerals. Greek called it "golden apple of the "Hesperides" because Zeus(male god) gave it to her bride (Hera) at their wedding. Cold expression extraction yield about 0.3-0.5%. *Citrus sinensis*, (also known as *Citrus auranticum var dulcis* and *citrus auranticum var sinensis*) or Portugal or China orange, is of the Rutaceae family. Orange oil has sweet and fresh smell, yellow in colour, watery in viscosity and has a shelf life of approximately 6months.

**Chemical composition:** Orange oil contains Limonene with aldehydes, citral, citronellol,  $\delta$ -3-carene,  $\beta$ -pinene. It also contain pectin, organic acids (citric, malic, acetic, formic),  $K^+$  salt, geraniol, linalool, methylanthranilate, terpineol,  $\alpha$ -pinene, cabinene, myrcene, neral (Shirley Price, 1993, Verzera et al., 2004, Ezejiolor et al., 2011; Schaneberg and khan, 2002; Linares et al., 2005).

**Therapeutic uses:** Sedative, anti-spasmodic agent, cholagonegsne, anti-hypertensive agent, treatment for irregular heartbeat, anti-inflammatory agent, reduces anxiety, treatment of insomnia, carminative agent, diuretic agent (Julia, 1995).

**Coconut oil:** Coconut is the nut (or fruit) of the coconut palm tree. It has a thick and fibrous husk that is used as a growing medium for plants. It is grown in tropical regions. It belong to the Arecaceae family (Palm family). Coconut is a species of *Cocos nicifera*. Coconut oil is also called fractionated, light or refined coconut oil. It is solid at room temperature at about 75°C. It has no scent and used as carrier oil and has a long shelf life as a bonus.

**Chemical composition:** Coconut oil contain mainly lauric acid (also found in human breast milk). Lauric acid protects infants from infections and diseases by boosting the immune system (Clarke Sue, 20083).

**Therapeutic uses:** Coconut oil is therapeutically used as an anti-cancer agent, fight against candida, yeast infection (anti-fungal agent), anti-microbial agent against Chlamydia, help in weight loss by boosting metabolism, hypoglycemic agent, provides energy for stimulating the thyroid gland, improves digestion, improves the immune system, anti-viral agent, Hepatitis C health agent, detoxifying agent (or body purifier or cleanser), dissolves kidney stones, activates sexual performance (coconut oil contain anti-oxidants that mops ups free radicals(ROS) that lowers libido, combat tooth decay (by helping stymie the growth of bacteria that is responsible for tooth decay), prevents osteoporosis (rat studies showed that it increases bone volume and structure), anti-stressing agent, anti- aging agent by improving cardiovascular system and because it contain anti-oxidant.

**Lemon oil:** Lemon is in the family of Rutaceae. Lemon essential oil is extracted from the *Citrus limonum* (also known as *Citrus limon*). Lemon oil is also known as Cedro oil (which refers to terpeneless oil). Lemon is a native of India. The name lemon is derived from Arabic word "laimun" or the Persian "limun" while the lemon tree was later brought to Europe by the crusader in the middle ages. It

contains vitamin A, B and C. Lemon oil is extracted from the fresh fruit peel by cold expression.

**Chemical composition:** Phytochemicals found in lemon oil are:  $\alpha$ -pinene, camphrene, citral, terpene associated with aldehyde of alcohol and ketone,  $\beta$ -pinene, sabinene, myrcene,  $\alpha$ -terpinene,  $\beta$ -bisabolene, linalool, limonene, nerol ( $\beta$ -citral), neral, trans- $\alpha$ -bergamotene, citric acids, geranial ( $\alpha$ -citral). Lemon oil is phototoxic. (Pengelly A, 2004; Robert Tisserand, 1995):

**Therapeutic uses:** Immune booster by supplying Vitamin C to immune cells, anti-bacteria and anti-viral agents, decrease anxiety, nervousness, dizziness and tension, stimulates the production of stomach acids, anti-hypertensive agent when taken with garlic and onion, anti-rheumatoid agent, anti-anemic agent, anti-sclerotic agent, diuretic, haemostatic agent, diaphoretic agent, carminative, febrifuga, rubefacient and vermifugal. (Adams Peggon, 2013)

**Therapeutic properties of other essential oils:**

Plants	Botanical Names	Uses
Tea tree	Melaleuca alterifolia	Anti-bacteria, anti-fungal and anti-viral agent.
Peppermint	Mentha piperita	Migraines(headache), fever, relieves nausea and vomiting during labor, fatigue, digestion.
German chamomile	Matricaria recutita	Anti-inflammatory agent
Bergamot	Citrus bergamia	Anti-depressant and tonic agent
Rosemary	Rosmarinus officinalis	Stimulant and anti-infective agent
Eucalyptus	Eucalyptus globulus, Eucalyptus radiata or Eucalyptus smithii.	Anti-respiratory infective agent
Lemongrass	Cymbopogon citratus	Anti-inflammatory agent
Basil	Ocimum basilicum	Anti-parasitic agent
Mandarin	Citrus reticulata	Anti-gastrointestinal tract agent and anti-hyperactive agent in children
Clover	Syzgium gromaticum	Topical analgesic, anti-spasmodic, anti-ementic(prevents and vomiting and nausea), carminative(prevents gas in the gut)
Geranium	Pelargonium graveolens	Diuretic, astringent(constricts body tissue so as to stop the flow of blood or other secretion).
Jasmine (Jasmin or Jessamine)	Jasminum gradiflora	Aphrodisiac properties
Sandalwood	Santalum album	Aphrodisiac properties
Thyme	Thymus vulgaris	Helps fatigue, nervousness and stress
Yarrow	Achillea millefolium	Anti-viral agent against influenza, anti-inflammatory, anti-rheumatoid arthritic agent).
Sage	Salvia officinalis	Boosting of short-term memory performance

**4. Mode of application of essential oils**

Mode of application	Purposes
Aerial diffusion	For environmental fragrancing or aerial disinfection.
Direct inhalation	For respiratory disinfection, decongestion, expectoration as well as psychological effects.
Topical application	For general massaging, bathing, compresses, therapeutic skin care.

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**6. Recommendations**

- 1) Based on the enormous benefits of essential oils, I recommend that countries especially developing countries should establish essential oil plants for accessibility and affordability.
- 2) Seminars, conferences and symposia should be conducted regularly to sensitize medical and health professionals on the uses and benefits of aromatherapy.
- 3) Agro-allied companies should be supported with micro-credit loans with no interest rate and farm implements for increase fruit production.
- 4) I also recommend that researchers investigate the synergistic action of Polyessential oils.
- 5) That essential oils should be used at the prescription of qualified medical personnels (or aromatherapist) discouraging unethical (or abusive) use of the product.
- 6) I also recommend that researchers investigate the hepatoprotective and anti-hyperglycemic effects of essential oils.

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