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Therapeutic Characteristics of Essential Oils: Historical and Scientific Considerations

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ABSTRACT: Essential oils (EOs) have been recognized globally for their medicinal value since ancient times. Records have shown that in Mesopotamia, Persia, ancient Egypt, China, and India, EOs were used in various forms to treat different ailments. However, their therapeutic property most often remained a mystery. EOs have been used in aromatherapy to heal both body and mind and as perfumes, fragrances, and flavors for foods and beverages. Essential oils are highly economically valued; peppermint, lavender, geranium, eucalyptus, rose, bergamot, sandalwood, and chamomile EOs are the most frequently traded. Additionally, EOs are exciting and powerful natural plant products with great religious significance, and as recorded in historical books, EOs such as frankincense and myrrh were among the important gifts usually offered to the kings as a symbol of protection and command of influence and attraction. This study presents the historical and scientific shreds of evidence surrounding the therapeutic characteristics of EOs. The myths and scientific facts based on chemical composition, about EOs are highlighted. A perspective is given on the best approach to using essential oils to achieve maximum results and future expectations about the science of essential oils.

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Aromatherapy has become a household term in recent years due to how powerful it can be when it comes to healing the body and mind. In this connection, essential oils (EOs) play a vital role in aromatherapy and are believed to exhibit profound curative potentials besides other arrays of applications. The practice of aromatherapy can be as simple as diffusing essential oils into the space around the body. The effects of aromatherapy act simultaneously on the mind, body, and soul offering a range of applications from the most basic skincare to the more meditative and sublime applications of essential oils (Cooke and Ernest, 2000; Farrar and Farrar, 2020). Naturally, many plants produce different amounts of EOs based on their seasonal influences and design for protection and attraction. As a means of protection, plants produce EOs as part of their stress response to changes in climate or to protect themselves from harsh environmental conditions and pathogens such as fungi, pests, and other invasive plants or animals (Lee and Ding, 2016). On the other hand, plants utilize their self-produced EOs to lure in pollinators

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with their irresistible fragrances (Prins *et al*., 2010; Lee and Ding, 2016). Similarly, since they are produced by the immune intelligence of the plants for protection and attraction when EOs are used by humans, they strongly support wellness and healthy stress response and offer enormous benefits from the vitality and health-producing effects of the oils. Furthermore, when a man or woman wears a pure, botanical aromatic treasure, the power of their attraction is naturally enhanced. "A woman wearing Night Blooming Jasmine can be irresistible to her lover." A drop of rose attar placed on the center of the chest can open the channels of love and compassion heart of a spiritual devote (Slavkovska *et al.*, 2005). The natural fragrance offers emotional benefits in addition to a fragrance that is harmonious with the composition and chemistry of the wearer. Essential oil which is a natural concentrated hydrophobic liquid containing volatile chemical compounds from plants or volatile oil of the particular source plant is believed to exhibit some attractive benefits in which health benefit is one.

Several studies have attempted to justify the therapeutic property of essential oils (Balz, 1996; Schnaubelt, 2011). Some have referred to it as a mystical oil that acts based on divine powers (Blackthorn, 2018; Orey, 2019), while some attribute its therapeutic functions to the chemical compositions which are scientifically based (Raut and Karuppayil, 2014; Han *et al*., 2017). There also exist some myths surrounding the functionality of essential oils. However, there is scarcely any well-documented information that establishes harmony within the historical, mythical, religious, and scientific shreds of evidence surrounding the therapeutic property of essential oils. The power of complete healing is predicated on the awesome wellness of the mind, body, and spirit. Essential oil is believed to exhibit such curative ability and this explains why it is more often used in aromatherapy (Ali *et al*., 2015). In this study, we present the historical, religious, and scientific pieces of evidence surrounding the therapeutic characteristics of essential oils as well as the myths and scientific facts based on EOs' chemical composition. We also recommend the best possible approaches to using essential oils to achieve maximum results.

Essential oils and their benefits: An essential oil may be referred to as a naturally concentrated hydrophobic liquid containing volatile chemical compounds from plants or volatile oil of the particular source plant. Essential oils are organic, volatile, liquids that are secreted by tiny structures in a plant's various parts such as the seeds, leaves, fruits, flowers, resins, and woods (Guenther, 2014). An essential oil gets its name from the plant from which it is derived. These oils were given the name "essential," because they were believed to capture a plant's essence, that is its odour and flavour. They lend plants their distinctive fragrance. Essential oils act as their original plant's defense mechanism and the extent of the defensive mechanism is dependent on the concentration of the phytoconstituent exhibiting the effect (Guenther, 2014).

In appearance, EO may be coloured or colourless. The coloured ones point to their therapeutic qualities. For example, EO such as chamomile oil which is blue in colour is useful for aromatherapy massage on a person experiencing red hot emotions, as the blue represents its classic "cooling and soothing" effect and counteracts any negative physical and psychological feelings (Stahl-Biskup, 2002). Oils such as Patchouli, Orange, and Lemongrass are amber or yellow in color and their bright happy colours are presumed to easily help a person determine what they are best used for – as mood boosters (Stahl-Biskup, 2002). Younger plants yield more essential oils than older plants, but the latter produces oils that are more resinous and darker in colour due to the continuous evaporation of the oil's lighter fractions. Sometimes their colours are a result of the extraction method while at other times the colour of the plant material affects the colour of the final product. While Chamomile is not blue, it contains a component called Chamazulene, which turns the oil an inky blue colour during the distillation process (Stahl-Biskup, 2002; Guenther, 2014).

Classes and Types of Essential Oil: Essential oils may be classified based on the chemical constituents as main terpenes (monoterpenes, sesquiterpenes), terpenoids (alcohols, phenols, aldehydes, ketones, esters, ethers, or oxides), amines and amides. They can also be classified based on their physical features as floral, minty, herbaceous, camphoraceous, spicy, woody/earthy, and resinous/musky essential oils. The most common means of classification are based on chemical constituents (Medina-Holguín *et al*., 2008; Falleh *et al*., 2020). The type of essential oil depends on its source of extraction. The various types of essential oils include basil sweet oil derived from the leaves of the *Ocimum basilicum* better known as the basil herb; cinnamon bark oil with sweetly spicy and woody essence obtained from the *Cinnamomum zeylanicum* tree, which is native to Sri Lanka; citronella essential oil derived from citronella plant commonly mistaken for lemongrass, as they share a similar appearance, growth, and processing method;

bergamot essential oil derived from bergamot tree (fruit) - *Citrus limetta* (a species of citrus commonly called sweet lemons or sweet limes; cedarwood essential oil steam distilled from the wood of the cedar tree (Falleh *et al*., 2020; Sadgrove *et al*., 2022). Other types include camphor oil, clary sage oil, clove bud oil, coffee oil, eucalyptus oil, frankincense oil, geranium oil, ginger oil, grapefruit oil, helichrysum oil, juniper berry oil, lavender oil, lemon oil, lemongrass oil, lime oil, myrrh oil, orange oil, oregano oil, peppermint oil, pine oil, rose geranium oil, sandalwood oil, spearmint oil, tea tree oil, thyme oil, turmeric oil, vanilla oil, ylang-ylang oil, and wintergreen oil. Table 1 summarizes the classes of essential oil based on chemical composition.

Table 1: Classes of Essential Oils Based on Chemical Compositions.

S/N	Class of Essential Oil	Description	Chemical Constituents	Ref.
1	Terpenes	Contains isoprene units, (carbon backbones of 2-methylbuta-1,3-diene) which can be rearranged into cyclic structures. Includes monoterpenes, sesquiterpenes and trace diterpenes, triterpenes, and tetraterpenes	Monoterpenes (2-isoprene): *Camphene, γ-3-carene, p-cymene (+)-limonene, β-myrcene, β-ocimene α-phellandrene, α-pinene, (+)-sabinene, α-thujene, α-terpinene, terpinolene*. Sesquiterpenes (3-Isoprene): *Aromadendrene, (−)-β-isabolene, α-cadinene, β-caryophyllene, β-cedrene, α-copaene, β-elemene, α-farnesene, (+)-germacrene-D, β-himachalene, α-humulene, γ-muurolene, α-zingiberene*	(Moghaddam and Mehdizadeh, 2017; Masyita *et al*., 2022)
2.	**Terpenoids**	Terpenes containing oxygen molecules. They include alcohols, phenols, aldehydes, ketones and lactones, esters, Carboxylic acids, ethers, and oxides	Alcohol: *Cinnamyl alcohol, geraniol, nerol.* Phenol: *Carvacrol, eugenol, thymol.* Aldehydes: *Cinnamaldehyde, citral, geranial, cuminaldehyde.* Ketones/lactones: *+)-Camphor, menthone, piperitone/Coumarin, alantolactone, nepetalactone.* Esters: *Benzyl acetate, eugenyl acetate, methyl salicylate, linalyl acetate.* Carboxylic acids*: Benzoic acid, cinnamic acid, valerenic acid*. Ethers and oxides: *Ethers (anethole, estragole, myristicin), oxides (β-caryophyllene oxide; 1,8-cineole; geranyl oxide), Ascaridole*	(Stephane and Jules, 2020)
	Phenylpropanoid	Formed from the six-carbon aromatic phenol group linked usually to the three-carbon propene tail of cinnamic acid, oxygenated in the third/fourth/fifth position and frequently possess a carbon–carbon double bond. Responsible for odour and flavour.	*(E)-Anethole, parsley apiol, α-asarone, cinnamaldehyde, chavicol, cinnamic acid cinnamic alcohol, elemicin, estragole, eugenol, methyleugenol, myristicin, safrole*	(Srivastava *et al*., 2022)

The Chemistry and Composition of Essential Oils: The chemistry of an essential oil is based on terpenes and its derivatives. Terpenes consist of isoprene units (carbon backbones of 2-methylbuta-1,3-diene) which can be rearranged into cyclic structures.

Terpene with one isoprene unit is called hemiterpenes (C_5), two units-monoterpenes (C_{10}), three units – sesquiterpenes (C_{15}), four units -diterpenes (C_{20}), six units- triterpenes (C_{30}) and so on. Terpenes or isoprenoids are the major constituents found in EOs. Monoterpenes are the predominant components of EOs (90%), followed by sesquiterpenes (Falleh *et al*., 2020; Masyita *et al*., 2022).

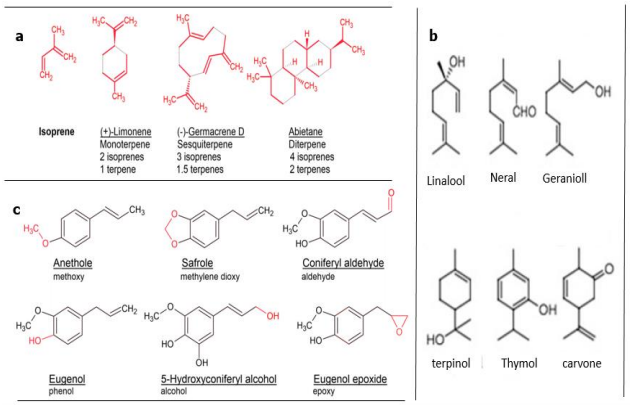

Fig.1: Structure of some Essential Oil Constituents (a) Terpenes (b) Terpenoids (c) Phenylpropanoids. Reproduced from (Sadgrove *et al.,* 2022). © 2022 by the authors.

Table 2: Selected Types of Essential Oil and Major Chemical Constituents

S/N	Essential Oil Type	Description	Major Constituents	Ref
1	Camphor Essential Oil	derived from the *Cinnamomum camphora* botanical and is also referred to as True Camphor, Common Camphor, Gum Camphor, 2and Formosa Camphor	a-Pinene, Camphene, Limonene, 1,8-Cineole, p-Cymene.	(Purkayastha and Nath, 2011)
2	Lemongrass Essential Oil	Also referred to as *Cymbopogon* and belongs to the *Poaceae* family of grasses	Myrcene, Citral, Citronellal, Geranyl Acetate, Nerol, Geraniol, and Limonene.	(Mukarram *et al*., 2022)
3	Clove Bud Essential Oil	Derived from the dried buds of the *Syzygium aromaticum L.* tree, indigenous to the Spice Islands of Indonesia	Eugenol, Eugenyl acetate and beta-Caryophyllene.	(Alma *et al*., 2007)
4	Bergamot Essential oil	Derived from Bergamot tree (fruit) - *Citrus limetta* (a species of citrus commonly called sweet lemons or sweet limes.	Limonene, Linalyl Acetate, Linalool, Pinene, Bergaptene, Terpineol, Nerol, Neryl Acetate, β-Bisabolene, Geraniol, Geraniol Acetate, and Myrcene.	(Costa *et al*., 2010)
5	Citronella oil	Derived from Citronella plant. commonly mistaken for lemongrass, as they share a similar appearance, growth, and processing method.	Geraniol, Camphene, Limonene, Methyl isoeugenol, Geranyl acetate, Borneol, Citronellal, and Citronellol.	(Wany *et al*., 2013)
6	Eucalyptus Oil	Derived from the Eucalyptus tree. The healing benefits of Eucalyptus Oil can be attributed to its anti-inflammatory, antispasmodic, decongestant, deodorant, and antiseptic qualities, among other valuable properties.	α-Terpineol, 1,8-cineole (Eucalyptol), α-pinene, β-pinene, Sabinene, Camphene, Limonene, p-Cymene, Camphor, Globulol, Citronellal, α-phellandrene, Aromadendrene, and Piperitone.	(Zhang *et al*., 2010)

Terpenes derivatives include terpenoids which are terpenes containing oxygen molecules that are constructed via biochemical modifications (removal or addition of methyl groups (predominant components of EOs (90%), followed by sesquiterpenes (Masyita *et al*., 2022). Terpenoids can be divided into alcohols, aldehydes, esters, ether, epoxides, ketones, and phenols. Other constituents include phenylpropanoids, amines, amides, and amino acids such as alanine, isoleucine, leucine, valine, and methionine. Figure 1 shows some structures of EO constituents while Table 2 shows some selected types of essential oils and major chemical constituents.

Benefits of Essential Oil: To speak of the benefits of something is to refer to the advantage or profit gained from that thing; or, to put it differently, it is about something "that produces good or helpful results or effects or that promotes well-being". In this connection, the benefits of EOs among many peoples of the globe can never be overemphasized. This is not very surprising since plants are known for their health benefits and pharmacological uses in general (Hamid *et al*., 2011). Tanu and Harpreet (2016) studies showed that the benefits can be from therapeutic or aesthetic values. As Mohamed and Alotaibi (2022) would say, "Since the earliest times, various aromatic herbs have been utilized as preservatives and curative agents and as the main source of aroma and flavor in the food industry. EOs are the main cause of the therapeutic effects in various aromatic herbs."

As regards its therapeutic benefit, Tanu and Harpreet (2016) stated that essential oils are used in the treatment of bacteria and viruses. They also affirmed how it is beneficial as an antioxidant as well as an anti-diabetic agent. Indeed, these plant products can be beneficial to humanity in chemoprevention and cancer suppression. Furthermore, EOs are beneficial as analgesic, embalming, spasmolytic, sedative, food preservation, localized anesthetic remedies, and anti-microbial (Kar *et al*., 2018). Other therapeutic benefits include the treatment of vaginal infections and rectal suppositories. Additionally, EOs are known for their aesthetic values with positive impacts such as aromatherapy. In some cases, they are known for their agricultural benefits in the control of pests (Regnault-Roger, 2013).

Others have further argued that: "Essential oils constitute a major group of agro-based industrial products and they find applications in various types of industries, such as food products, drinks, perfumes, pharmaceuticals, and cosmetics"

(Regnault-Roger, 2013). Furthermore, they are employed in the absorption of skin, inhalation, and ingestion. They are considered to be extremely valuable as they possess the capacity to pass through the blood-brain barrier due to their minute molecular structure. They can have a positive influence on one's mental performance, concentration, and moods. Furthermore, EOs stimulate the body to release antibodies, neurotransmitters, endorphins, hormones, and enzymes (Lv *et al*., 2013).

Therapeutic potentials of essential oils

Historical Evidence: Historically, essential oils, or aromatic oils as they were once called, have been used by many cultures around the world for centuries. Their usage varied from healing, religious, culinary, and cosmetic purposes. It is difficult to pinpoint exactly when EOs gained popularity as effective curative agents. However, studies have shown that the knowledge of essential oils started spreading around the globe as far back as 18,000 B.C.E. (Zielinski, 2018). The earliest evidence of human knowledge of the healing properties of plants was found in Lascaux, located in the Dordogne region in France, where cave paintings suggest the use of medicinal plants every day (Kubeczka, 2020). It should be noted that the first records of EOs came from ancient Persia, India, and Egypt. Again, Greece and Rome conducted extensive trade in odoriferous oils and ointments with countries of the Orient (Wallach, 2023). The Egyptians used aromatic oils as early as 4500 B.C.E. They became renowned for their knowledge of cosmetology, ointments, and aromatic oils (Elshafie and Camele, 2017). Chinese first recorded the use of aromatic oils between 2697-2597 B. C. E. during the reign of Huang Ti (Kubeczka, 2020). During the fall of the Roman Empire, Romans used essential oils in massages and baths and were also known for lavishly applying perfumed oil to their bodies, bedding, and clothes. In Persia, they were found to be of immense use around 1037 A.D when Ali-Ibn Sana recorded a simple method for distilling the oil. Furthermore, EOs found prominence in Europe around the 14th century. During the Bubonic Plague of the 14th Century, frankincense and pine were burned in the streets of Europe to ward off "evil spirits". It was noted that fewer people died of the plague in the areas where the frankincense was burnt. In 1928, French Chemist René-Maurice Gattefossé published a book "Aromatherapie" in which details cases of EOs and their healing capabilities were presented (Kubeczka, 2020).

Myths, Misconceptions, and Facts about Essential Oils and Their Therapeutic Characteristics: There are several myths and misconceptions about essential oils which quite often influence the general perceptions about essential oils' therapeutic characteristics. Ward *et al*. (2020) discussed how EOs have been misrepresented from different points of view. Table 3 summarises some of the myths and misconceptions surrounding the therapeutic properties of EOs, and facts debunking the false claims.

Religious Evidence on Essential Oils' therapeutic Properties and Benefits: The Bible, as an ancient containing historical and spiritual texts, is replete with references to essential oils and their mother plants (Matthews, 2009). Possessing oil is indicative of a blessed life in the Bible. Thus, Proverbs 21:20 affirms that In the house of the wise are stores of choice food and oil. From the Biblical perspective, therefore, essential oils have multiple references showing myriads of emotional, physical, and spiritual benefits as well as healing properties.

In the Old Testament (OT), the common Hebrew term is *shemen.* As *shemen*, it occurs about 170 times in different contexts, while its synonym *yisḥār* occurs about 20 times. Other terms are *mishḥāh* occurs 22 times, and its Aramaic equivalent, *meshah* occurs only twice in Ezra 6:9 and 7:22 (Renn 2012). Renn (2012) explained that in all these contexts, EOs are used both literally and metaphorically. They are also classified according to their mundane and spiritual (or religious/cultic) uses. In its mundane usages, they occur in Exod 27:20; 35:14; 39:37ff.; Num 4:9; 2 Sam 1:21; 1 Kgs 5:11; 17:12ff; 2 Kgs 4:2; 18:3; 2 Chron 32:28; Neh 5:11; Ezra 3:7; Esth 2:12; Job 24:11; Prov 21:17; 27:9. In these contexts, essential oils were used as either fuel for lamps, perfume, or spices But there are also instances where essential oils were used as cosmetics as indicated in Pss 23:5; 104:15; Mic 6:15; 2 Sam 14:2; Deut 28:40.

Matthews (2009) stated how in the Bible, essential oils were important items of trade in the ancient world in the forms of perfumes and spices. As perfumes, they were variously referred to in Hebrew as "*rôqēaḥ* (Exod 30:25, 35; 37:29; Eccl 10:1), *raqqāḥ* (1 Sam 8:13; Neh 3:8), *mirqaḥaṯ* ((2 Chr 16:14), *riqqûaḥ* (Isa 57:9), *rîaḥ* (Exod 30:38), *nûp* (Prov 7:17), *qeṭōreṯ* (Prov 27:9), *mequṭṭereṯ* (Cant 3:6), *bātê hannepeš* (Isa 3:20), *bōśem* (Isa 3:24)." Meanwhile, spices are also called *bōśem* in Hebrew. All these are considered essential oils as they were extracted in ancient times, primarily from plants, through either the distillation process or expression. They were all "associated with aromatic oils, perfumes, incense, and embalming substances"

(Matthews, 2009). As perfumes and spices, they were hardly used for food purposes, except in Lev 24:7, where they were used in a cultic context to garnish the Bread of the Sanctuary (van Beek, 1958). Rather, they were used primarily as cosmetic treatments (Esth 2:13); as substances to freshen garments (Ps 45:9) and their pharmaceutical or aphrodisiac values (Gen 30:14-15; Cant 7:13) or as balm [Jer 8:22] (Zohary, 1982).

Table 3: Myths, Misconceptions, and Facts Regarding Essential Oils Therapeutic Properties

S/N	Myths and Misconceptions	Facts
1	Essential oils are more harmful than fragrance oils.	This is not true. Fragrance oils are synthetic or man-made and often contain harmful chemicals (Picone *et al*., 2021). In addition, fragrance oils have the same harmful ingredients as essential oils such as limonene, linalool, geraniol, citronellal, etc. Therefore, in many cases, both can be equally harmful. Still, essential oils are considered safer when used correctly because they do not contain harmful additions such as phthalates, parabens, and silicones.
2	Essential oils are safe because they are natural.	This is not true. The fact that something is natural does not mean it is safe. Essential oils are potent, natural chemicals and should be used with caution. For example, poison ivy and poisonous mushrooms are both natural, but they can cause serious health problems if they are not used correctly.
3	All essential oils are the same.	This is not true. Each essential oil has its unique blend of aromatic compounds that give it its unique properties. Therefore, it is important to do your research before choosing an essential oil to use for a specific purpose.
4	Essential oils contain vitamins, minerals, or hormones.	This is not true**.** Essential oils are made up of volatile compounds, which means they do not contain vitamins, minerals, or hormones. However, many essential oils do have antibacterial, antifungal, and antioxidant properties.
5	Essential oils can be used to treat medical conditions	This is not true. While essential oils can help manage symptoms, they should not be used to treat medical conditions. If you have a medical condition, it is always important to consult a healthcare professional before using any essential oil.
6	The more the quantity of EOs you apply the better	This isn't always true when it comes to essential oils. Using too much essential oil can be harmful. Many businesses still suggest applying essential oils in various ways (cleaning, eating, topical, etc.). Our bodies' response to essential oils is improved when they are used in moderation. However, our bodies become tolerant or even sensitive to them over time after continuous excessive usage.
7	Pure essential oil is automatically a high-quality one.	Purity is an indicator of but is not necessarily synonymous with, quality.
8	Conventional essential oils are less 'pure' than organic oils.	The purity of essential oil can be tested and assured whether or not it is certified organic. That said, an appropriate organic certification can provide some added confidence that extra care has been taken to avoid contamination with substances that are not routinely tested for, such as pesticides.
9	The blot test - and other 'home tests' - will let me know if my essential oils are pure or not.	The blot test is an out-of-date technique as adulteration by diluting in vegetable oils is now seldom practiced. Other home tests are rarely reliable.
10	Essential oils are only useful for therapeutic (physical) reasons.	We're delighted that aromatherapy is now recognized as a healing art grounded in chemistry and scientific studies, but we do not allow that to limit our relationship with essential oils. Our universe is comprised of much more than science can give a name to. We are complex beings of body, mind, emotions, and spirit. Essential oils can help balance us on all of these levels. Sit with your oils. Connect with them energetically and allow the transformation to occur.

In the New Testament (NT), the Greek rendering is *elaion* and it appears 10 times (Renn, 2012). Here, essential oils were considered a household commodity (Matt 25:3ff; Luke 16:6; Rev 6:6; 18:13). As medication or healing ointment, they are seen in Mark 6:13; Luke 10:34; Jas 5:14. As cosmetics, it is used in Luke 7:46. In Matt 2:11, frankincense and myrrh together with gold were used metaphorically to respectively denote the divinity, salvific death and the kingship of Jesus Christ. Again, it is referred to as the "oil of joy" regarding the anointing of the Son of God (Heb 1:19). Finally, Table 4 further shows other emotional and physical benefits of essential oils that are found in the Bible.

Essential Oils at Ceremonies, Cultic Worship, and Religious Feasts: From the spiritual point of view, essential oils in the Bible were used at religious ceremonies, cultic worship as well as religious feasts. To begin with, they were regarded as sacred commodities. Accordingly, Exod 30:23-25 aptly describes them as "Holy Anointing Oils," as the following quote affirms: "Take the finest spices: of liquid myrrh five hundred shekels, and sweet-smelling cinnamon half as much, that is, two hundred

and fifty, and of aromatic cane two hundred and fifty, and of cassia five hundred, according to the shekel of the sanctuary, and of olive oil a Hin; and you shall make of these a sacred anointing oil blended as by the perfumer; a holy anointing oil it shall be" (Exodus 30:23-25, RSV).

In other Biblical texts, they were used as commemoration of divine revelation (Gen 28:18; 35:14). They were also used in religious ritual anointing of priests who were to serve as ministers of tabernacle (Exod 25:6; 29:7, 21; 30:24ff; Lev 8:2, 10ff; 10:7; 21:10ff; Zech 4:14), as well as in other religious ceremonies" (Matthews, 2009). Moreover, van Beek avers that some spices were included in materials within a cultic context (1960). Kings like Saul, David, and Solomon also received spiritual endorsement for political services and administration through anointing with holy oils (1 Sam 10:1; 16:1, 13; 1 Kgs 1:39; Ps 89:20). In addition, offerings and sacrifices in the OT included the use of EOs as noted in Exod 29:40; Lev 2:1ff. 6:15; 7:10ff; Num 7:13ff.; 15:4ff; 28:5ff). From the same context, Ezra 6:9 and 7:22 involved the use of essential oil as a spiritual perspective in the reconstruction of the Jerusalem Temple after the Babylonian Exile (Renn, 2012).

Table 4: Biblical References to Essential Oils which are known for emotional and physical Benefits.

Essential Oil Type	***Bible Reference Text* (RSV)**	***Benefit(s)***
Cedarwood	Leviticus 14:4 – "The priest shall command them to take for him who is to be cleansed two living clean birds and cedarwood and scarlet stuff and hyssop".	Emotional: associated with survival, first Chakra. Physical: may help with ADHD, skin problems, hair loss
Cinnamon Bark (Cassia)	Proverbs 7:17- "I have perfumed my bed with myrrh, aloes, and cinnamon".	Emotional: associated with balance for feelings of irritation (head of the pancreas). Physical: may help with infectious diseases (viral) and cardiovascular
Cypress	Isaiah 44:14 – "He cuts down cedars or chooses a cypress...."	Emotional: associated with the ego (tip of xiphoid process), feelings of worthlessness (gums and teeth). Physical: may improve circulation, antispasmodic, liver health, and anti-infectious.
Frankincense	Lev 2:2; Matt 2:11 and over 52 other references, including the term "incense" which is translated to mean frankincense. It was considered the "holy anointing oil" and known for its healing powers. As indicated above, it was one of the gifts given to Christ at his birth. It was valued more than gold and was used to treat every conceivable ill.	Emotional: associated with the ego (tip of xiphoid process), feelings of worthlessness (gums and teeth). Physical: may improve depression & immuno-stimulant.
Hyssop	Leviticus 14:4 – "…and hyssop"	Emotional: associated with swallowed emotions (epiglottis). Physical: decongestant, anti-microbial.
Myrrh	Genesis 37:25 – "… a company of Ishmaelites came… bearing spicery and balm, and myrrh…"	Emotional: fear of facing the world (adrenal glands). Physical: antioxidant, antimicrobial.

Significance of Myrrh and Frankincense as Essential Oils: Myrrh is a product of a small tree called the dindin tree which is usually about 5 to 15 feet tall and one foot in diameter. Frankincense, also called olibanum, "is a tree with papery bark, sparse bunches of paired leaves and has flowers with white petals with red or yellow centers that grow without soil" (Flowers-Kimmerle, 2021). Myrrh and frankincense were rare products and in high demand by the upper class (Le Maguer-Gillon, 2015). The significance of myrrh and frankincense is first of all seen in the fact that they constituted a huge source of economic commodity among nations in the Bible (Matthews, 2009). Thus, among the commodities that were trafficked by Roman merchants as attested in Rev 18:13 were myrrh and frankincense. Van Beek also testifies that frankincense and myrrh were very important items throughout the Bible and the Bible itself shows its significance as it indicates that it was a basis for economic activities even for ancient South Arabia which was known for the exportation of these items (de Vaux, 1997). In addition, Miller (1969) averred that the "Eastern trade routes stretched along the coast of Africa down Somaliland and Madagascar, across the Indian Ocean to Indonesia, and all along the Persian Gulf and W cost of India." As economic commodities, they were easier to deal with as they did not require any form of industrialized refining. "They were simply transported to buyers and burnt as incense," even though myrrh could further be pulverized into powder forms (Matthews, 2009).

From the religious point of view, Exod 30:34 and Lev 2:2 affirm that frankincense "was primarily burnt as incense in religious ceremonies" (Matthews, 2009). Lev 24:7 also refers to the use of frankincense in a cultic context (Van Beek, 1960). In Rev 5:8, one reads of the use of incense in a spiritual or cultic context to signify the presence of prayers in religious worship. de Vaux (1997) refers to incense used in worship as *q^e^toreth* which means either "that which goes up in smoke" or "perfume offerings." He further argues that such use of incense was not peculiar to ancient Israel alone but also among Egyptians. Similarly, Rev 8:3-5 indicates its use in intense worship that attracts strong divine presence and even theophany. Additionally, in Matt 2:11 frankincense and myrrh together with gold were used metaphorically to respectively denote the divinity, salvific death, and the kingship of Jesus Christ. In Lev 24:7, frankincense was used as part of the requirement for the bread to be kept in the sanctuary to be later consumed by Aaron and his sons, while myrrh was used as incense in Temple worship (Exod 30: 23).

Some other uses are considered to be more profane than spiritual; myrrh was significant as a painkiller when mixed with wine as in the case of Jesus on the cross (Mark 15:23). In John 19:39, it was used in combination with aloes to embalm the body of Jesus as well as line the linen shroud for his burial (Matthews, 2009). Scholars (Hussain *et al*., 2016) maintained that while Pliny the Elder believed that frankincense is a good antidote to hemlock poisoning, Avicenna – a physician from Iran – considers it a remedy for a wide range of body ailments and in China and some of the East, it served as remedies for both internal and external maladies. Moreover, myrrh together with aloes and cassia were considered to be sources of fragrance for robes of royalty and the rich class (Ps 45:7-8). Meanwhile, myrrh alone was used as a fragrance to freshen the body wears (Ps 45:23) and as a cosmetics treatment (Esth 2:13). Finally, these items were used to enhance diplomatic relationships or as an offering to broker peace. A handy example of such is attested in Gen 43:11 as Jacob's gifts to Pharaoh (Matthews, 2009).

In Christian worship or liturgy, the significance of incense is seen its prevalent uses in Mass in the West and East since the 9th Century A.D. Referring to incense and its uses, Caseau (2007) stated that "a perfect aroma was, for the Christians too, an attribute of the divine. Perfumes were believed to be powerful on spiritual and divine beings." In these contexts, it represents spiritual realities. Thus, the smoke symbolizes many things: purification and sanctification of items incensed such as the bread and wine, the altar, the book of the Gospel, the officiating priest/ministers and the people at worship, and the Paschal Candle during the Easter period (Deavel, 2005). Additionally, it symbolically represents the rising to heaven of the prayers of the worshipping community (Caseau, 2007).

Zimmerle (2021) wrote of the great significance of frankincense from an Islam perspective. He writes that "Indeed, this was so much the case that it is almost impossible for scholars to approach the question of Arabian trade before the Hellenistic period without presuming that this trade involved principally the gum resin frankincense, the most famous fragrant substance throughout history." That their use was prevalent is substantiated by evidence of their burners both for local use and in commercial quantities (Zimmerle, 2021). Thus, from an Islamic perspective, the use of frankincense (called *al-luban*) was attested in Oman as early as the 3rd millennium B.C. It was also used in the Arabian Temple and the domestication of camels. These usages lasted up to the Islamic periods. Its widespread use in the Islamic context is indicative of the fact at the Christianization of the region, its trade, and patronage around Mecca, and the trade between Arabia and the Mediterranean world saw a heavy decline (Le Maguer, 2015). It has been mentioned that Ibn al-Qayyim, speaks of the medicinal values of frankincense in Islam and had recommended that believers should fumigate/burn frankincense and thyme in their houses; use it as a remedy for memory loss or forgetfulness, and that it is helpful for stomach aches, sharpening vision and indigestion (Ally, 2015).

Scientific Evidence of Essential Oil Therapeutic Characteristics Based on Chemical Composition: The therapeutic property of essential oils may depend on the chemical constituents of the oils. Various scientific pieces of evidence have been documented in the literature (Ekanem *et al*., 2024; Oforma *et al*., 2019; Udourioh and Etokudoh, 2014; Costa *et al*., 2010; Purkayastha and Nath, 2011). For example, camphor essential oil has the following major chemical constituents: alpa-pinene, camphene, limonene, 1,8-cineole, and p-cymene (Purkayastha and Nath, 2011). Pinene is known to exhibit anti-inflammatory, anti-septic, expectorant, and broncho dilatory activities; camphene is known to exhibit anti-oxidant, soothing, and anti-inflammatory activities; Limonene is known to exhibit the following activities: anti-inflammatory, anti-oxidant, nervous system stimulant, psychostimulant, mood-balancing, appetite suppressant, detoxifying, digestion enhancing ability; 1,8 cineole is known to exhibit the

following activities: analgesic, anti-bacterial, anti-fungal, anti-inflammatory, anti-spasmodic, anti-viral, increased blood flow, reduced tension headaches, anti-tussive, expectorant, cough suppressant; para-cymene is known to exhibit anti-oxidant, sedative, soothing, neuroprotective, anti-anxiety, anti-inflammatory activities (Purkayastha and Nath, 2011). The various medicinal activities confer on it a unique healing potential. Similarly, lemongrass essential oil contains the following major chemical constituents: myrcene, citral, citronellal, geranyl acetate, nerol, geraniol, and limonene. Myrcene is known to exhibit anti-inflammatory, analgesic, anti-biotic, anti-mutagenic, and sedative activities; citral exhibits anti-viral, anti-septic, and anti-oxidant activities; citronellal exhibits anti-fungal, sedative, anti-viral and anti-microbial activities; geranyl acetate exhibits anti-fungal, anti-microbial and anti-inflammatory activities; nerol exhibits anti-oxidant, sedative, anti-inflammatory and anti-depressant activities (Mukarram *et al.,* 2022); geraniol exhibits anti-oxidant, anti-bacterial, anti-septic and analgesic activities; neral exhibits apoptotic, anti-nociceptive and anti-inflammatory activities; limonene exhibits anti-oxidant, digestive, appetite suppressant and detoxicant activities (Mukarram *et al*., 2022).

Medicinally, Lemongrass essential Oil's analgesic properties have been found to relieve muscle and joint pains caused by overexertion of muscles through exercise. It is known to boost energy and reduce fever as well as headaches caused by viral infections such as the flu. It acts as an antiseptic, making it a beneficial ingredient in lotions and creams that prevent wounds from becoming infected. By alleviating abdominal pain, it can relieve stomach aches and ease spasms in the digestive tract. It works as a detoxifying agent by increasing perspiration, thus promoting the expulsion of bodily toxins through sweating. Several other scientific pieces of evidence are available in the literature on the curative capability of the different classes and types of essential oils (Mukarram *et al*., 2022).

Antibacterial Properties of Essential Oils: Studies have shown that essential oils exhibit strong antibacterial properties. The mechanism of action as antibacterial agents may depend on the type and sources of the essential oil. However, the general considerations from various studies have indicated that essential oils may possess antimicrobial properties which could replace conventional synthetic antibiotics (Anupama *et al*., 2019). A team of researchers in 2021 tested the antibacterial activity of EO extracted from *Pinus sylvestris,* against some bacterial isolates such as *Corynebacterium pyogenes, Bacillus anthracis, Bacillus polymyxa, Proteus Vulgaris, Bacillus cereus, Staphylococcus aureus, Bacillus stearothermophilus, Bacillus subtilis, Enterococcus faecalis, Micrococcus luteus, E. coli, Klebsiella pneumonia, and Pseudomonas fluorescens;* and discovered that the *Pinus sylvestris* needles EO showed different ranges of zone inhibition with growth inhibition of all the tested bacterial isolates at an appreciable MIC ranging between 0.39 and 1.56 mg/mL except for P. vulgaris, which also had the lowest ZOI (8 mm) (Oyewole *et al*., 2021). The highest antibacterial activity was found against *Klebsiella pneumonia and Micrococcus luteus* while the lowest activity was found against *Pseudomonas fluorescens* (Oyewole *et al*., 2021).

In a study by Hao *et al*. (2021), the antibacterial activity and mechanism of *Litsea cubeba* essential oil (LCEO) were investigated against *Acinetobacter baumannii*. The LCEO showed a strong antibacterial activity against *A. baumannii.* And when the activity of protein synthesis was inhibited, the normal physiological metabolism of bacteria was affected, leading to cell death (Hao *et al*., 2021).

In another set of studies, EO from a tea tree was examined and found to suppress the progress of *S. aureus* and *E. coli* by changing cellular permeation, enhancing the depletion of inner cellular potassium ions (Vengatesan *et al*., 2021). It was also reported to have disrupted the organization of un-similar fatty acid, lipids, and polysaccharides substances (Roman *et al*., 2021). The antibacterial activities of the EOs have been attributed to the various chemical constituents including terpenes, alcohols, acids, esters, epoxides, aldehydes, ketones, amines, and sulfides. The specific constituents include terpineol, thujanol, myrcenol, neral, thujone, camphor, and carvone, α-terpineol, borneol, fenchol, palmitic acid, caryophyllene, oleic acid, δ-cadinene etc. (Calo *et al*., 2015).

Fig. 2 shows the probable antibacterial mode of activity of EOs. EOs of numerous medicinal and aromatic plants are stated to produce enhanced microbial cellular membrane permeation results in the escape of cell substances and lack of ions (Raut and Karuppayil, 2014). The EOs initially destabilize the cell framework, results in the breakage of the cell membrane surface and enhanced permeation that interrupts the various cell actions (Hamdaoui *et al*., 2018). The EOs might disrupt the exterior surface of the cell along with its cytoplasmic wall and simply enter into the microbial cellular substances owing to their hydrophobic nature (Nazzaro *et al*., 2013).

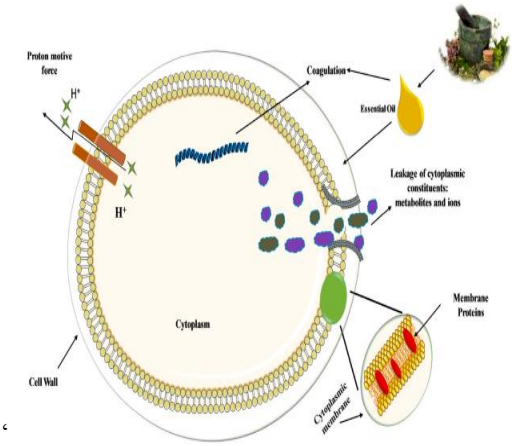

Fig. 2: Antibacterial mode of action of EOs on bacterial species. Reproduced with permission from Hou *et al*. (2022). Copyright © 2022 Elsevier B. V. Ltd.

Antifungal Properties of Essential Oils: Essential oils are known to control various fungi and molds that cause various diseases in plants, animals and humans. The antifungal activities are most often attributed to the presence of phytochemical components. EO is particularly recommended to be one of the most potent alternative fungal inhibitor products amongst others (Aleksic and Knezevic, 2014). Most crop EOs show high ecological protection, which is generally recognized as safe by renewable materials of the food drug administration and less risk of developing tolerance in pathogenic microbes (Prakash *et al*., 2012).

By way of action, essential oils penetrate and disrupt the fungal cellular structure and intracellular membranes via a mechanism of permeation which contributes to the dissolution of mitochondrial cells (Singh *et al*., 2017). The typical case of the mode of action of essential oil against fungal species and their constituents is presented in Fig. 3. using EO from turmeric (Aysegul *et al*., 2020). Here, the essential oil causes cytoplasmic coagulation, alters the intra and extra cellular ATP and ATPes, alters the membrane fatty acids, and affects the activity of the mitochondrial dehydrogenases (Hou *et al*., 2022; Aysegul *et al*., 2020).

Abdelfattah *et al*. (2022) evaluated the antifungal activity of essential oil, extracted from the leaves of Moroccan *Withania frutescens L.,* against *Fusarium oxysporum* (BMFS19) isolates and discovered that the mycelia growth was strongly inhibited in a dose-dependent manner (0.28 – 9 mg/mL) (Abdelfattah *et al*., 2022). The extremely reactive oxygen species in EOs can affect cell wall, cell division, or attack pathogenic traits such as fungi-to-hyphal transition, biofilms, and cell adhesion. Candida cells cellular membranes are amongst the spore's cell's most significant targets (Singh *et al*., 2016). It is well known that several antifungal drugs attack the cellular structure and the extracellular matrix. Eugenol, a phenylpropene derived from clove essential oil, has established physicochemical effects which are beneficial in fighting disease caused by Salmonella typhi bacterium and Proteus mirabilis. Candida was already believed to be caused by destroying cell walls. This impairs the permeability of the cell membrane and improves the permeation and flexibility of the cells (Moumni *et al*., 2020). Major antifungal components of essential oils include Diallyl thiosulfinate, Linalool, Methanol extract, Anethole, Oilsalmond, Carvacrol, D-limonene, sedanolide, Cineole, Zingerone, D-carvone, Aromadendrene, Bicyclogermacrene, Spathulenol, Germacrene D, and Cinnamaldehyde (Hou *et al*., 2022).

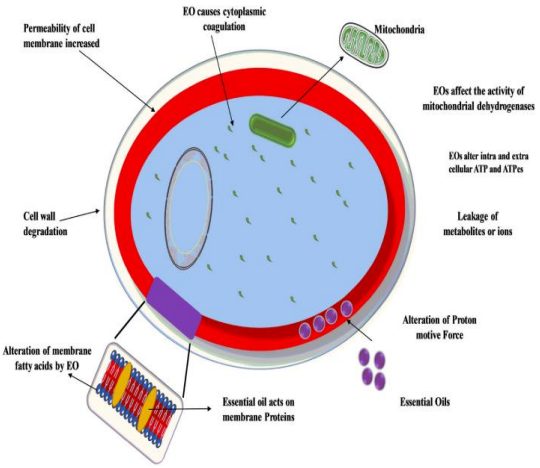

Fig. 3: Mode of action of EO against fungal species and their constituents. Reproduced with permission from Hou *et al*. (2022). Copyright © 2022 Elsevier B. V. Ltd.

Anticancer Activities of Essential Oils: Anticancer activity of EOs from various plant species have been reported by several authors (Rajiv-gandhi *et al*., 2020; Ali *et al*., 2020; Sugier *et al*., 2020). In most of the reports, the mechanism of action of the essential oils may involve targeting distinct biological pathways and the cell cycles. Many biological pathways are employed to induce cancer cell apoptosis. Apoptosis is a biological process of programmed cell death which occur in all multicellular organisms. It is used to rid the body of cells that have been damaged beyond repair. It plays a role in preventing cancer. The biological pathways employed to induce cancer cell apoptosis, and their associated signals are active in normal cells but are suppressed in cancer cell (Shukla *et al*., 2022b). In this case, EOs with curative and suppressive properties act by chemoprevention and cancer cells

suppression (Gautam *et al*., 2014). It has been shown that EOs have an effect on the process of tumor inhibition in mammalian replicas, which is one of the many pathways linked with the cytotoxic effects on cancer cells (Gautam *et al*., 2014).

Following an intrinsic pathway, it was reported that *Salvia aurea, Salvia judaica,* and *Salvia viscosa* EOs exhibited the potential to suppress the growth of human melanoma cell lines M14, A2058, and A375. As measured by the Caspase colorimetric test kit, the oils were able to inhibit the progression of cancer by stimulating the death of the cancer cells via the process of apoptosis (Russo *et al*., 2016). Sage (Salvia aurea L.), (Salvia judaica Boiss.) and (Salvia viscosa) essential oils acted on human leukemia cell line (HL-60), MCF-7, PC-3, A-549 and MDAMB-231, HL-60 cell by Inhibits the cell proliferation in and apoptosis by expression of Bcl-xL, caspase-3, -8, -9 and PARP-1 cleavage (Russo *et al*., 2016). Fig. 4 shows an overview of effect of essential oils on intrinsic, extrinsic and PARP inhibition pathways operating in cancer cells. In the intrinsic pathway, the essential oil increases the expression of BAX and caspase 3. For the extrinsic pathway, essential oil (shown as yellow droplets) acts on caspase 7, while in the PARP inhibition pathway, the essential oil prevents the binding of NAD^+ and catalyses the binding of PARP inhibitor (Sharma *et al*., 2023).

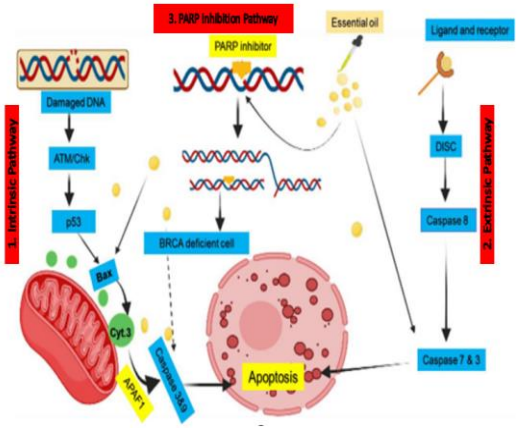

Fig. 4 An overview of effect of essential oils on intrinsic, extrinsic and PARP inhibition pathways operating in cancer cells. Reproduced with permission from Sharma *et al*. (2023). Copyright © 2023 SAAB by Elsevier B.V.

Furthermore, essential oil of *Boswellia scara* has been reported to have inhibited cdk4 and cyclin D1 cancer cells (Suhail *et al*., 2011), while *Chenopodium botrys L*. essential oil acted on HeLa cancer cells by expression of p21 and p53, intrinsic apoptosis pathways and arresting cell proliferation (Rezaieseresht *et al*., 2020). Fig. 5 shows the anticancer activity of EOs targeting cell cycle. From the figure 5, the essential oil of *Boswellia sacra* inhibits cdk4 and cyclin D1 and essential oil *Chenopodium botrys* increases the G1/G0 phase of cell cycle and stimulate p21 which was directly navigated by p53, causing an arrest in the cell cycle at the G1 phase (Rezaieseresht *et al*., 2020; Sharma *et al*., 2023).

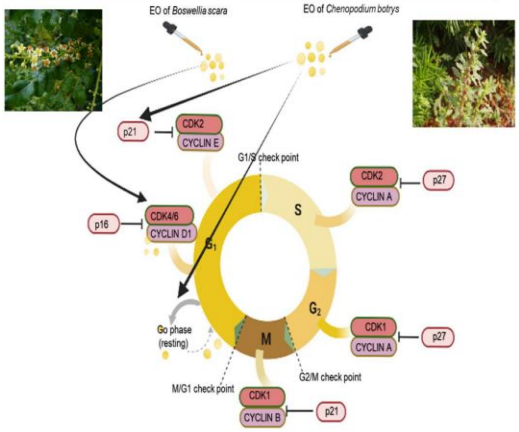

Fig. 5: Anticancer activity of EOs targeting cell cycle. Reproduced with permission from Sharma *et al*. (2023). Copyright © 2023 SAAB by Elsevier B.V.

In addition to the antibacterial, antifungal and anticancerous properties of EOs discussed in this work, there are also reports on EOs as exhibiting antioxidant (Afoulous *et al*., 2013; Khiyari *et al*., 2014; Jeldi *et al*., 2022; El Hachlafi *et al*., 2023) and antiinflamatory (Afoulous *et al*., 2013; Pereira *et al*., 2023), antibiotic (Jugreeta and Mahomoodally, 2021), antidiabetic (El Hachlafi *et al*., 2023), antimalarial (Afoulous *et al*., 2013) and insecticidal (Khiyari *et al*., 2014; Demeter *et al.,* 2021) activities.

Perspective and prospects on the use of essential oils: As evidenced in the foregoing discourse, essential oils have been recognized globally to have powerful medicinal values since ancient times. Historical books have shown several instances where different types of essential oils were used with the utmost benefit. They have more often been used for healing, aromatherapy, and other therapeutic purposes. The increased patronage of traditional or natural medicine these days is centered on the powerful action of essential oil constituents. From various scientific analyses, essential oils contain several organic constituents capable of exhibiting powerful therapeutic properties. The bioactive compounds found in EOs, especially terpenes and terpenoids possess a wide range of biological activities including anticancer, antimicrobial, anti-inflammatory, antioxidant, antiallergic, anti-bacterial, anti-septic, analgesic, apoptotic, anti-nociceptive, anti-fungal, sedative, anti-viral, soothing, nervous system

stimulant, psychostimulant, mood-balancing, expectorant, broncho dilatory, neuroprotective and anti-anxiety. The activities are attributed to the chemical constituents. These activities offer essential oils unique healing abilities. For example, lavender essential oil massages can reduce anxiety and lower blood pressure. Inhaling a few drops of essential oils in boiling water may assist with headaches, depression, or insomnia. Lavender oil also can calm and relax the nerves. Garlic essential oil is a source of sulfur compounds recognized for their preventive effect against cancer (Milner, 2001).

Essential oils are natural gift to humanity. It should therefore be properly and fully utilized. To achieve maximum results with the use of essential oils, it is important to properly identify the specific needs for the essential oil and search for the particular essential oil that matches the needs based on the chemical compositions. This could be achieved by consulting qualified aromatherapists. Attention should be paid to the cautions for each essential oil application method. It should be noted that essential oils enter the body in three ways: through inhalation, ingestion, and skin application. Ingestion and skin application of EOs can be achieved topically using compresses, sprays, baths, or massaging.

The EOs application method depends on the essential oil selected, condition to be treated, and the desired effect. For example, some essential oils are irritating to the skin because of their chemistry. These may need more dilution or better be used by inhalation. Wound care most often involves topical applications. Mood effects might be addressed by either inhalation or topical application. For fast action, inhalation might be preferred. Baths involve both inhalation and topical absorption.

At any point of uncertainty about the application method to use with essential oils, a qualified aromatherapist or essential oil specialist should be consulted. Considering the huge potential of essential oil as a powerful healing agent, and with the growing trends in aromatherapy and traditional medicine, the science of essential oils is gaining renewed attention. Findings have also shown that EOs have the potential to preserve food matrices from various microbes and maintain desired quality, influence cooking, and increase the shelf life of food products (Rout *et al.*, 2022). The future of the science of essential oil is therefore promising.

Conclusion: This study set out to investigate the therapeutic property of essential oils based on data provided by historical and scientific records. In this connection and even without intending a pun, one can say that essential oils have essential components that offer essential and immense benefits in pharmacology leading to complete healing of the body. They come from a variety of sources and are classified based on their chemical constituents - mainly terpenes, terpenoids, amines, and amides – and physical features as floral, minty, herbaceous, camphoraceous, spicy, woody/earthy, resinous/musky essential oils. Mythical records about them may have led to misconception and even misuse; however, the facts and truth about them are by far quite overwhelming. This is evidenced by the historical and scientific realities known about them. Thus, their medical, spiritual, mental, and aromatic benefits can hardly be exaggerated. They find applications in the cosmetic and food industries. They are endowed with interesting biological activities and have a therapeutic potential that may enhance their uses as natural remedies and as suitable therapy for many pathologies. Perhaps further scientific study may reveal greater and wider prospects and perspectives on the use of essential oils. This would also boost the economic significance globally since they are known to be widely used in their different products.

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