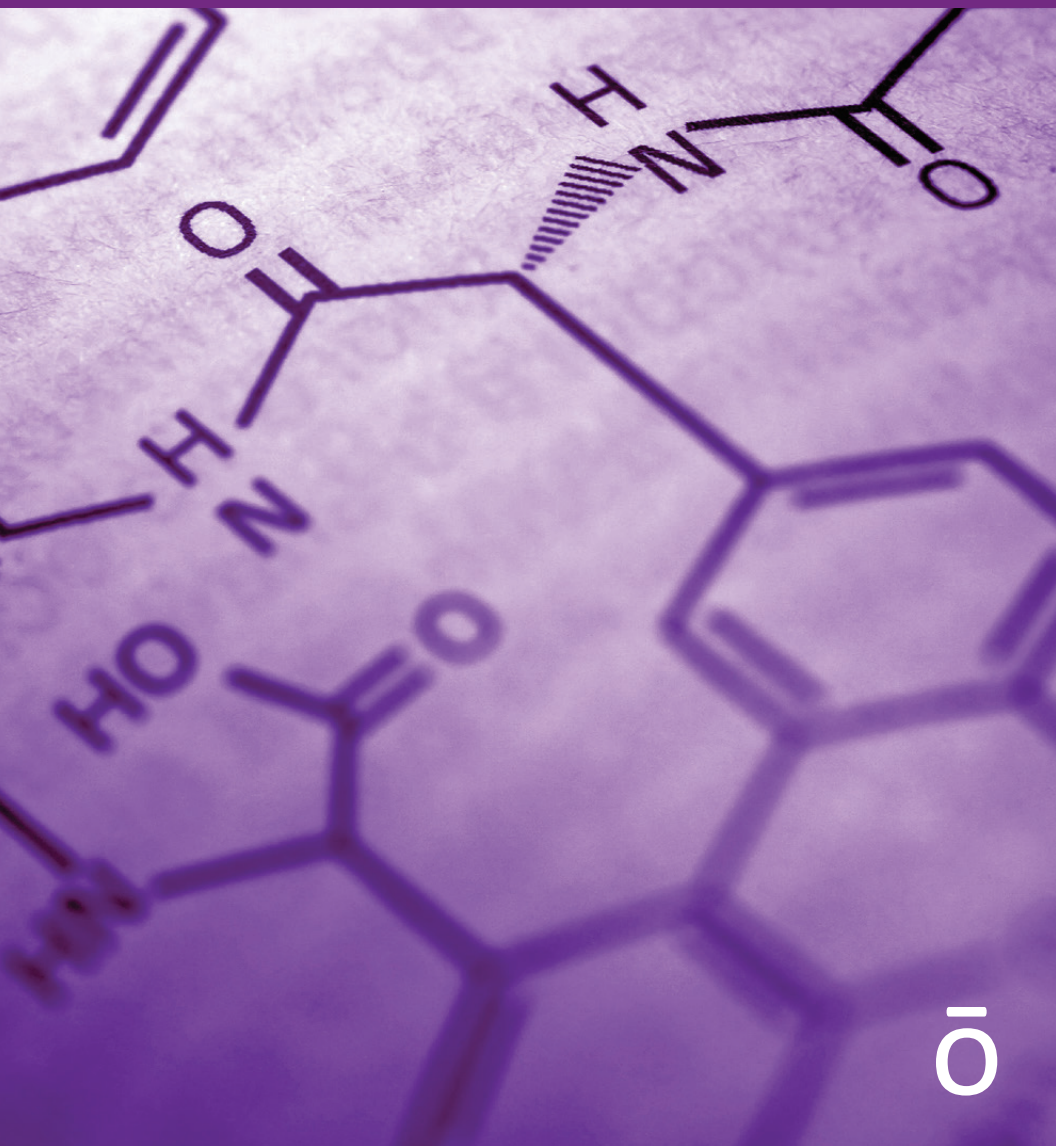
THE dōTERRA ESSENTIAL OIL CHEMISTRY HANDBOOK 2nd edition

Edited by Dr. David K. Hill, D.C.



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FOREWORD

Dear friends,

I, like you, have a passion for essential oils. They have played a significant role in both my professional and personal life for many years. I remain convinced that the benefits of essential oils are unique and almost universally applicable to all who choose to experience them.

I am so pleased to be a part of dōTERRA and to participate in the progress and discovery of essential oils. They have found their rightful place in science, healthcare, and most importantly, in individualized approaches to health and wellness. Through my own experience, I have learned the importance of quality, and I think it is significant that dōTERRA stands alone as the sole provider of the highest quality essential oils in the world.

It is my pleasure to introduce to you the dōTERRA Essential Oil Chemistry Handbook. I am confident that it will help you expand your knowledge of essential oils and empower you to use them more effectively. It is my sincere desire that this chemistry compendium will enhance your own experience, providing you with the basic framework from which you can develop your own personalized model of self-care and affording you the opportunity to share dōTERRA essential oils with others more meaningfully and in a way that is scientifically correct.

With kindness,

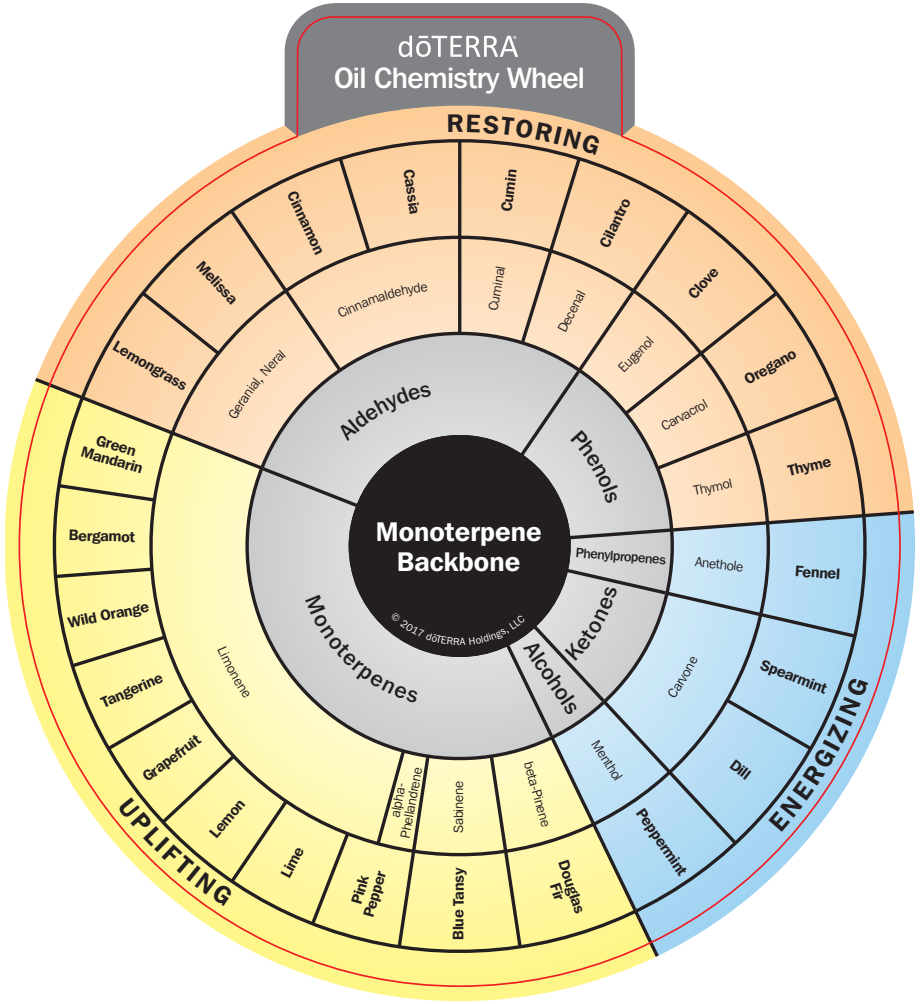
Dr. David Hill

THE dōTERRA OIL CHEMISTRY WHEEL

The dōTERRA Oil Chemistry Wheel is a tool designed to help individuals better understand the chemistry behind essential oils. In understanding the basic chemistry of each oil, individuals can more fully understand when and how to use the oils to achieve a desired benefit.

The dōTERRA Oil Chemistry Wheel is now divided into two wheels, each with two sides. The first wheel gives information on oils high in **monoterpenes** (oils that have a 10-carbon backbone). One side of the monoterpene wheel describes oils with lifting properties, and the other side presents oils with leveling properties. The second wheel contains information about oils high in **sesquiterpenes** (oils that have a 15-carbon backbone) on one side, with a legend on the opposite side. In each of the chemistry wheels, the oils are further organized by functional group, with the top one or two chemical constituents listed under each oil. The four sides of the two chemistry wheels are presented in the following pages.

The oils in the dōTERRA Chemistry Wheels are grouped according to their shared key properties. The shared key properties provide a starting point for understanding how to use the oils. The combination of these different groupings enables individuals to begin to understand the characteristics and properties of dōTERRA's amazing essential oils.



Restoring: These are oils for emotional and physical support. They are meant to help revive, strengthen, and rejuvenate the body and the senses.

Uplifting: These oils are meant to be inspiring. They encourage feelings of exhilaration, refreshment, and enlivening.

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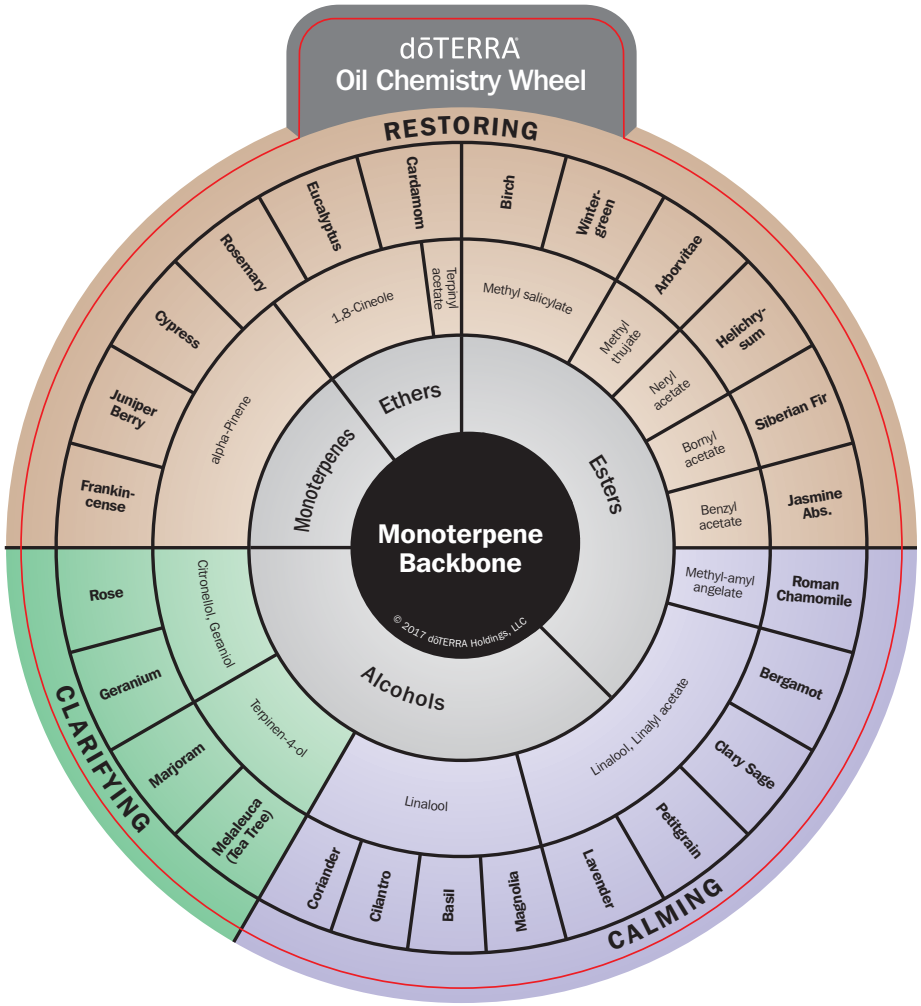
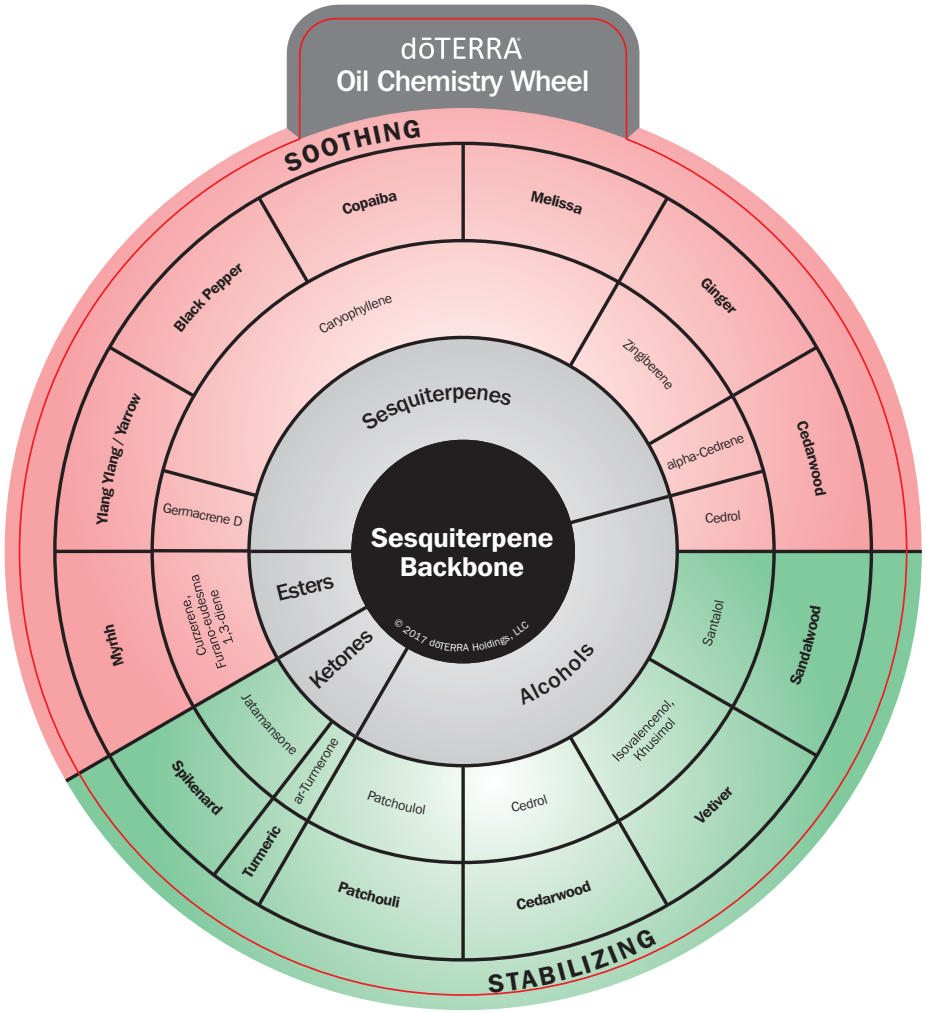
Energizing: These oils are used to bring feelings of motivation and activation. They tend to be brisk, naturally stimulating oils that help wake up the mind and body.





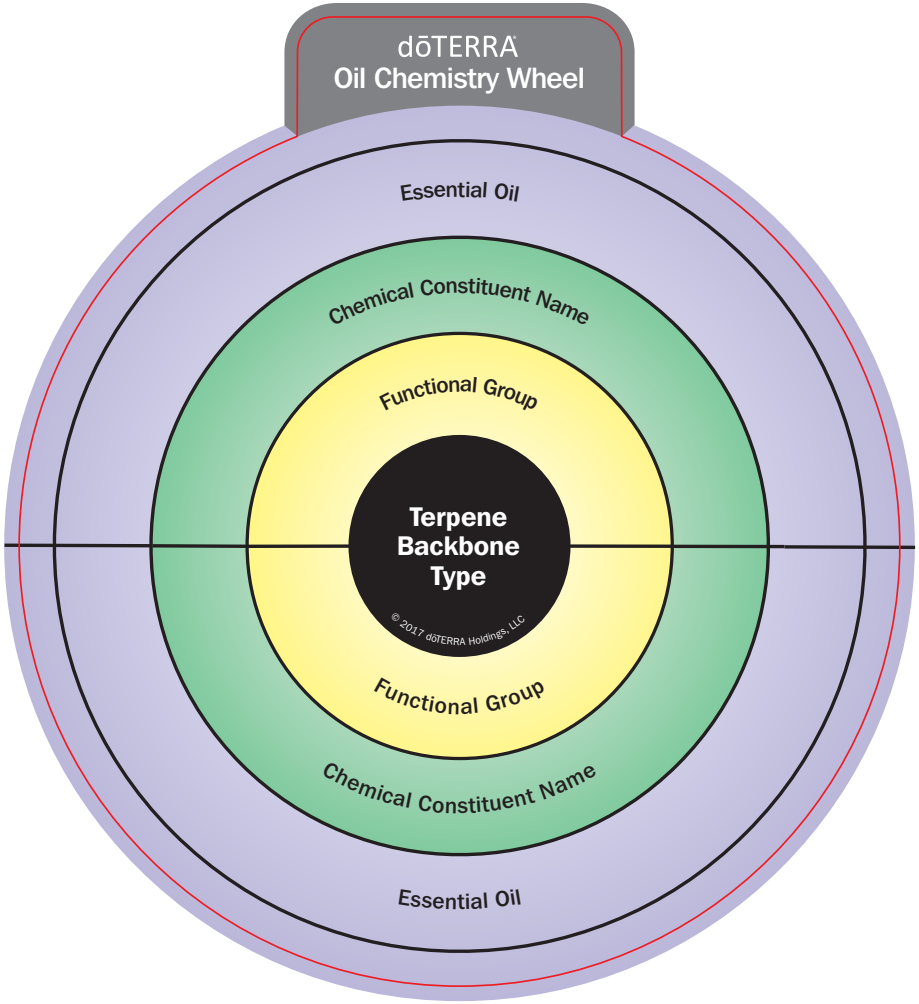
Restoring: These are oils for emotional and physical support. They are meant to help revive, strengthen, and rejuvenate the body and the senses.

Clarifying: As the name implies, these are oils that help to "make clear." Topically they are used for improved skin tone and appearance, and emotionally they can be used to help settle and resolve ambiguous, uncertain feelings.

Calming: These are classic oils for feelings of relaxation, both physically and mentally. These oils are typically used for stress relief, meditation, and preparation for sleep.

Soothing: These are oils that help ease and alleviate issues, both emotional and physical. They are meant to reassure and console as needed.

Stabilizing: These are oils that help steady the nerves, helping you feel that you are on an even keel. By analogy, stabilizing oils encourage a person's feelings and emotions to go from a rocking boat to standing on solid ground.



Terpene Backbone Type: Specifies the carbon backbone structure of the chemical constituents in the oil. Usually the backbone type is either monoterpene or sesquiterpene.

Functional Group: Indicates the presence of a specific arrangement of atoms within the constituent molecule that has distinct chemical properties.

Chemical Constituent Name: The chemical names for the main compounds found in each oil.

Essential Oil: Gives the names of the dōTERRA oils with the backbone, functional group, and constituent composition that fit into the chemical categories explained above.

PART 1: **THE BASICS OF ESSENTIAL OIL CHEMISTRY**

Everything is chemistry. Every cell, organ, and tissue in the body performs its function using enzymes, receptors, and other proteins, which work together to break down, build up, and rearrange the chemical bonds in biological molecules. Essential oils also operate under the principles of chemistry. In fact, the chemical makeup of essential oils is what gives them the ability to affect the body's systems. Molecules in essential oils can selectively support the function of subcellular structures that run the processes that keep us alive.

By understanding the fundamentals of oil chemistry, you can begin to classify oils by their chemical properties. This will help you learn which oils might have applications in different daily life contexts and how they work. This portion of the Oil Chemistry Handbook will give you the intellectual tools you need in order to understand how to use essential oils effectively and how to share them with others.

In Part 1, generalizations are made based on chemistry to help develop a conceptual framework for grouping and categorizing oils. Because this framework is so compact and simple, there will, of course, be exceptions. Before using any of the oils mentioned in this section, be sure to refer to Part 2 of this book for the suggested uses and skin sensitivity associated with each specific oil.

This reference is designed for a general audience with basic knowledge of chemistry. The content in Part 1 provides background information on essential oils and the basics of general and organic chemistry before delving into essential oil chemistry. The chemical structure of essential oil molecules, the functional groups, and their uses are then outlined in detail.

Read through this section carefully; it will provide you with the background knowledge necessary to understand the detailed chemical information on essential oils and their constituents contained in Parts 2 and 3.

CHAPTER 1: **AN INTRODUCTION TO ESSENTIAL OILS**

1.1 WHAT ARE ESSENTIAL OILS?

Essential oils are called "essential" because they are the "essence" of a plant. In the Middle Ages, it was believed that essential oils were essential for life, giving them the moniker that has stuck even to the present day. Modern references define an essential oil as the essence, or extract, that is the source of a plant's aroma and flavor. For example, peppermint plants smell like peppermint because of the essential oil contained in their leaves and stems. Oranges smell like oranges because of the essential oil contained in the peel.

Why do plants produce essential oils? Essential oils are a critical part of a plant's immune system. Plants produce essential oils to protect themselves against environmental threats. The parts of a plant with the greatest amount of essential oil are usually the parts with the greatest risk for invasion by microorganisms: the bark, sap, leaves, seeds, and fruit rinds. The compounds found in essential oils have all sorts of biological activities. They are known to protect against environmental threats, soothe the body, and even calm the mind.

1.2 OBTAINING ESSENTIAL OILS FROM PLANT PARTS

While it is important to note that essential oil extraction is unique to every plant, in general, dōTERRA essential oils are extracted using one of three methods: steam distillation, cold press, or solvent extraction.

Steam Distillation is the most common method for collecting essential oils. In steam distillation, water is boiled and the resulting steam passes through the plant material. The steam carries the essential oil from the plant into a collecting tube, where the steam is cooled and condensed back into water. Because essential oils are lipid soluble (meaning that they mix readily with other oils), they are

easily separated from the water.

Cold Press is a method that doesn't involve heat. Cold press extraction is used exclusively with citrus fruits because it is a way of extracting oil from the outermost layer of the fruit's peel. The fruit is passed across sharp rasping cylinders that abrade the surface of the peel to break open small essential oil-containing sacs. Water is then sprayed over the fruit to collect the essential oil. The resulting watery mixture is then filtered and centrifuged to separate the essential oil from the water.

Solvent Extraction can be used on every type of plant material, but is most commonly used on flowers that are too fragile to endure the conditions required for steam distillation. The plant material is washed with a solvent to dissolve out the fragrant compounds. The resulting mixture is then filtered to remove the plant material, and then the solvent is removed using vacuum distillation. The yield of this process is a thick, waxy material called a "concrete." The concrete is processed again in a similar fashion but with a different solvent. After another round of vacuum distillation to remove the second solvent, a pure mixture of only absolute remains. Common absolutes extracted by this method are Jasmine and Vanilla.

1.3 ESSENTIAL OILS ARE COMPLEX MIXTURES OF AROMATIC COMPOUNDS

Essential oils are made of volatile aromatic compounds. Volatile aromatic compounds are small organic molecules that tend to change from the liquid state to the gas state at room temperature. These molecules are so incredibly small that a single drop of essential oil contains around 40,000,000,000,000,000,000 (40 million trillion) of them. The word "volatile" emphasizes their tendency to evaporate quickly at room temperature. This property is what makes them smell so potent. When you first open a bottle of essential oil, you instantly notice the aroma, and you can smell it even from a distance. The

physical and chemical properties of volatile aromatic compounds allow them to quickly enter the gas state, move through the air, and directly interact with olfactory sensors in the nose.

Essential oils can be made up of anywhere between 1 and 1000 different compounds with different chemical identities. For example, Birch oil is almost entirely composed of one compound: methyl salicylate. Spikenard, on the other hand, contains hundreds of compounds. Most oils fall somewhere in between these two extremes. For instance, Frankincense essential oil contains over 65 distinct chemical compounds in various quantities.

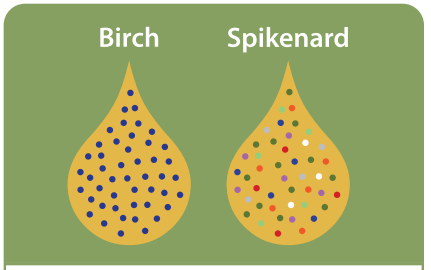


Figure 1.1: A single drop of essential oil contains around 40 million trillion molecules. The chemical identity of these molecules depends on the essential oil. An essential oil can have anywhere between 1 and 1000 different chemical constituents with distinct chemical identities.

The different compounds in an essential oil are known as constituents. Each constituent has its own distinct structure, meaning that the shape, size, and arrangement of chemical bonds in that molecule is unique. The different constituents in an essential oil determine both the oil's aroma and the benefits it offers.

The exact composition of an essential oil varies between plant species. When speaking of essential oils, the word "composition" refers to the oil's constituent makeup or, in other words, what chemical constituents it contains and how much of those constituents are present. For instance, Bergamot essential contains over 35 different compounds, but it has especially high levels of two constituents called limonene and linalyl acetate. Blue Tansy essential oil, on the other hand, contains over 50 compounds, with the two most abundant constituents being chamazulene and sabinene.

CHAPTER 2: **ESSENTIAL OIL ORGANIC CHEMISTRY**

2.1 OILS USAGE IS LINKED TO OIL CHEMISTRY

Again, everything is chemistry. Chemical structure influences how substances are absorbed and metabolized, how they smell, and what their biological activities are. By understanding the fundamentals of oil chemistry, you can learn to categorize oils by their chemical properties. This will help you understand how to use them effectively and how to share them with others.

Perhaps you want to enjoy the skin-supporting properties of Geranium, but you don't particularly like its aroma. Maybe you just used your last few drops of Frankincense and you need to find something else for your daily support of healthy cellular function.* Or maybe you are crafting your own blend to meet a specific set of health needs or to create a specific aroma. If you have the information about essential oils' chemical composition and you know how to use it, you can skillfully do any of these tasks. In fact, the more you understand chemistry, the more effectively you will be able to use essential oils in general. In this section, we will describe two common ways of categorizing essential oils based on chemistry: carbon backbone and functional groups.

2.2 THE CARBON BACKBONE

Organic chemistry is the study of organic molecules. In chemistry, the word "organic" means "carbon-based." So organic chemistry literally means "the study of carbon-based molecules." Understanding the basics of organic chemistry is essential for understanding essential oils because every aromatic molecule is made of carbon atoms joined together by chemical bonds. The portion of a molecule comprised of a chain of carbon atoms is known as the carbon backbone.

Chemists use special diagrams called Lewis structures to map out the detailed structure of a molecule. For example, **figure 2.1** is a Lewis structure depicting the essential oil constituent limonene. The letters in this diagram represent atoms. "C" stands for carbon, and "H" stands for hydrogen. The lines represent chemical bonds between atoms and the double lines represent double bonds. Notice how the molecule's shape is determined by the carbon backbone. You may have also noticed how complicated the diagram is. A more compact way to depict the backbone structure is by using a carbon skeleton diagram **(figure 2.2)**. Because of their simplicity, carbon skeleton diagrams are the most commonly used chemical diagrams for depicting organic molecules.

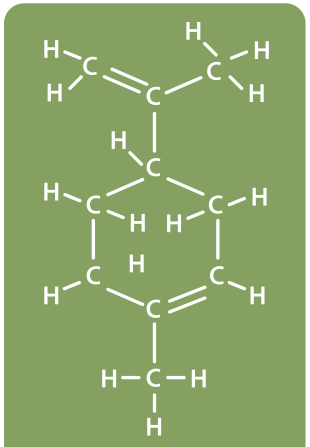


Figure 2.1: *Lewis structure of limonene. Note the complexity of the diagram.*

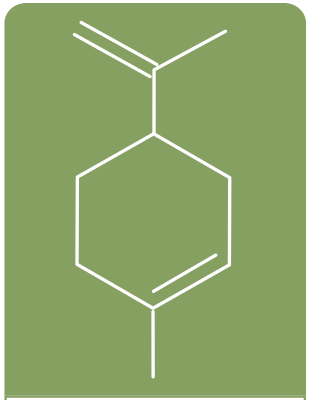


Figure 2.2: *Carbon skeleton diagram of limonene. Note that H's and C's are not shown, greatly simplifying the diagram.*

Carbon skeleton diagrams show the structure of an organic compound in a similar fashion to Lewis structures, but there are a few key differences. Take a moment to look at the differences between **figure 2.1** and **figure 2.2.** In the skeleton diagram, hydrogens are left out and the carbons are not labeled. Since the bonds are still shown, you can tell where the carbons are because they exist at either end of a line representing a bond.

Terpenes are the class of aromatic molecules synthesized by plants. Every plant has hundreds of special enzymes called terpene synthases that work together to build these compounds out of smaller

building blocks called isoprene units, which have five carbons. There are three main kinds of terpenes: monoterpenes, sesquiterpenes, and diterpenes. Diterpenes are sometimes present in essential oils, but only in very small amounts. Their large molecular weight keeps them from evaporating during steam distillation. Monoterpenes and sesquiterpenes are the main compounds found in essential oils. Due to their differences in size and structure, monoterpenes and sesquiterpenes have different effects on the body.

Monoterpenes are found in some amount in almost all essential oils. They have a structure of 10 carbon atoms derived from two isoprene units and at least one double bond. Monoterpenes can have a straight-chain backbone or a single ring **(see figure 2.3)**. Due to their smaller size, they tend to react quickly to air and heat, and they tend to be broken down more quickly than their more complex sesquiterpene counterparts. Monoterpenes have strong effects on cell membranes because they are small enough to fit between the fatty molecules that make up the cell membrane. They are also small enough to completely pass through it and affect targets inside the cell. There are believed to be well over 2,000 varieties of monoterpenes, each with its own unique biological activity.

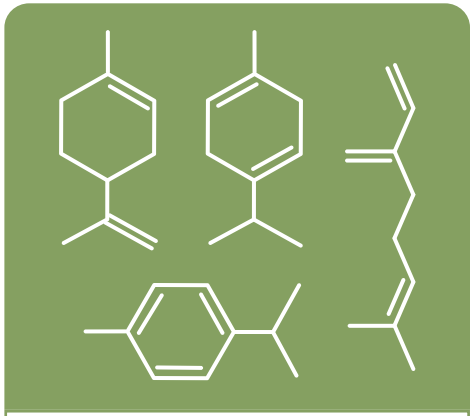


Figure 2.3: *Some common monoterpenes include limonene (top left), gamma-terpinene (top middle), myrcene (right), and para-cymene (bottom).*

Sesquiterpenes have a structure of 15 carbon atoms derived from three isoprene units. Because of their higher molecular weights, sesquiterpenes are less volatile than monoterpenes and are therefore less prevalent in essential oils overall. It is believed that there are over 10,000 different varieties of sesquiterpenes.

Sesquiterpenes can have a straight-chain backbone, one ring, or two rings **(see figure 2.4)**. Sesquiterpenes aren't quite small enough to pass through the cell membrane as efficiently as monoterpenes, but they have unique shapes that allow them to adhere to pockets in three-dimensional protein structures, affecting protein activity. Sesquiterpenes are known to activate various cell surface receptors.

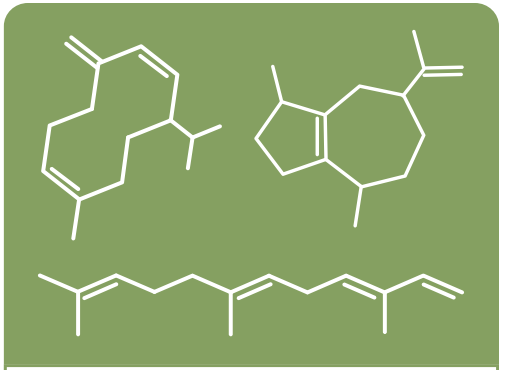


Figure 2.4: *Some common sesquiterpenes include germacrene (top left), guaiene (top right), and farnesene (bottom).*

2.3 INTRODUCTION TO FUNCTIONAL GROUPS

Another way to characterize essential oils is based on functional groups. Functional groups are easy to spot on a skeleton diagram because they are spelled out, in contrast to the carbon and hydrogen molecules, which are omitted. For instance, the letters "O" and "H" (representing oxygen and hydrogen) are spelled out in the carbon skeleton diagram of an alcohol, which is one specific kind of functional group **(see figure 2.5)**.

Functional groups are distinct groups of atoms within a molecule, but they have characteristic properties that manifest themselves regardless of the other atoms contained within the molecule. For instance, menthone and carvone are both ketones, meaning that somewhere in their

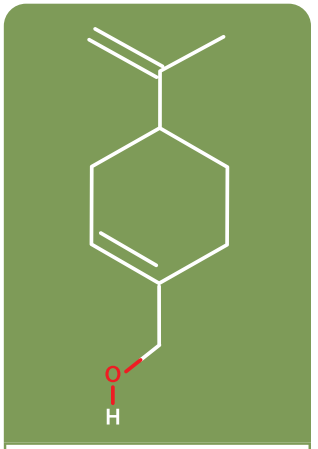


Figure 2.5: *A monoterpene with an alcohol functional group*

structure they both contain a special kind of double bond with an oxygen atom. For instance, experimental research suggests that essential oils rich in menthone or carvone (i.e., Peppermint and Dill) can be soothing to the tissues and also support digestive function.* Although categorizing oils by functional group does not tell the entire story of use and efficacy, it is clear that it can provide a meaningful framework for daily usage of essential oils.

CHAPTER 3: THE FUNCTIONAL GROUPS AND THEIR FUNCTIONS

There are more than 20 different functional groups in organic chemistry, but there are only 8 main functional groups found in essential oil constituents. The functional groups in essential oils are alcohols, aldehydes, alkenes, ketones, esters, ethers, phenols, and phenylpropenes. In this chapter, we'll discuss the atomic structure of each of these functional groups, their properties and potential uses, and examples of oils and constituents that contain these functional groups.

It is important to realize that functional groups and carbon backbones are two separate features of aromatic compounds. This means that a molecule can be both a monoterpene and an alcohol at the same time. Likewise, there are molecules that are sesquiterpene alcohols, monoterpene aldehydes, sesquiterpene ketones, etc. Every possible combination of terpene and functional group represents its own unique class of molecules.

In this section, generalizations are made based on chemistry to develop a conceptual framework for grouping and categorizing oils. There will be exceptions to these generalizations. For example, while many alcohols have health benefits when taken internally, some are not recommended for internal use.

Before using any of the oils mentioned in this section, be sure to refer to Part 2 of this book for the suggested uses and skin sensitivity associated with each specific oil.

3.1 ALCOHOLS

An alcohol is any molecule with an alcohol functional group. An alcohol group consists of an oxygen atom bound to both the carbon backbone on one end and a hydrogen atom on the other end (see figures 3.1 and 3.2). In general, alcohol molecules have names ending with the suffix –ol. For instance, menthol, terpinen-4-ol, citronellol, geraniol, and linalool are examples of monoterpene alcohols. Santalol, isovalencenol, khusimol, cedrol (also known as eudesmol), and patchoulol (also known as patchouli alcohol) are sesquiterpene alcohols. One exception to this naming rule is the compound eucalyptol, which is actually an epoxide (a type of ether).

Figure 3.1: *An alcohol group*

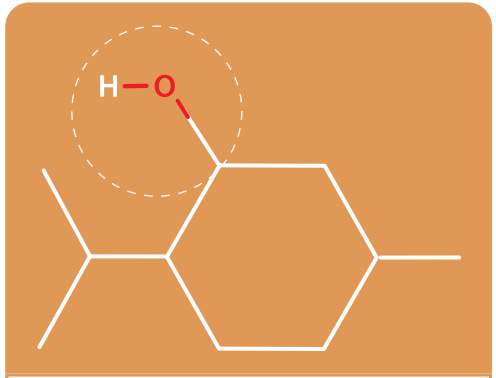


Figure 3.2: *An example of an alcohol group found in menthol, a monoterpene alcohol found in peppermint oil*

Properties and Uses of Alcohols

Aromatic: Relaxing aromas, helps soothe anxious feelings
Topical: Repellant activity, cleansing properties, helps the skin look young and healthy
Internal: Supports the circulatory system, calms the nervous system*

Oils high in monoterpene alcohols: Melaleuca, Geranium, Coriander, Basil, and Lavender

Oils high in sesquiterpene alcohols: Sandalwood, Vetiver, Cedarwood, and Patchouli

3.2 ALDEHYDES

An aldehyde is a molecule with an aldehyde group. An aldehyde group is characterized by a carbon double bonded to an oxygen **(see figures 3.3 and 3.4)**, where the same carbon atom is also bonded to both a hydrogen (not shown) and another carbon in the molecule's main backbone. In general, aldehyde molecules have names ending with the suffix –al or –aldehyde. For instance, geranial, neral, cinnamaldehyde, cuminal, and decenal are examples of monoterpene aldehydes. Santalal, farnesal, and valeranal are examples of sesquiterpene aldehydes. Sesquiterpene aldehydes are far less common than monoterpene aldehydes.

Figure 3.3: *An aldehyde group*

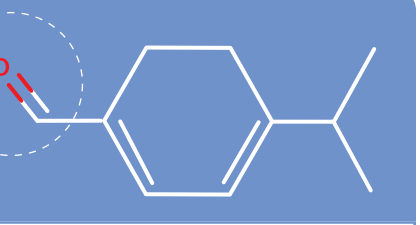


Figure 3.4: *An example of an aldehyde group in the compound terpinen-7-al, a monoterpene aldehyde found in cumin essential oil*

Properties and Uses of Aldehydes

Aromatic: Calming, relaxing, and protecting
Topical: May reduce the appearance of blemishes, keep skin looking healthy, support oral health and hygiene, and provide a warming sensation to the skin
Internal: Supports the health of the cardiovascular, digestive, immune, and nervous systems. Many essential oils high in aldehydes are also known to support healthy metabolism.*

Oils high in monoterpene aldehydes: Cassia, Cinnamon, Melissa, Lemongrass, and Lime

3.3 ALKENES

An alkene is a molecule with no functional groups present and at least one double bond between any two of the carbons in its backbone. Alkene molecules usually have names that end with the suffix –ene. For instance, alpha-pinene, sabinene, limonene, and gamma-terpinene are examples of monoterpene alkenes. Germacrene D, caryophyllene, zingiberene, and alpha-cedrene are examples of sesquiterpene alkenes. Each of the molecules in figures 2.3 and 2.4 are alkenes: they have no other functional groups and at least one double bond between carbons. In fact, most of these molecules have many double bonds.

Monoterpene and sesquiterpene alkenes are well-known for their antioxidant properties.* The large number of double bonds and the existence of ring structures in these molecules makes them excellent at accepting the lone electrons contained in free radicals.

Properties and Uses of Alkenes

Aromatic: Many unique and pleasant fragrances
Topical: Antioxidant benefits for the skin and the tissues
Internal: Antioxidant benefits for the internal organs, may also support the nervous, immune, digestive, reproductive, integumentary, and circulatory systems*

Oils high in monoterpene alkenes: Frankincense, Douglas Fir, Blue Tansy, Lemon, and Wild Orange

Oils high in sesquiterpene alkenes: Ylang Ylang, Black Pepper, Copaiba, Melissa, and Ginger

3.4 ESTERS

An ester is a functional group that results from the reaction between an alcohol and an acid. Esters have a central carbon atom double bonded to an oxygen atom, single bonded to the backbone, and single bonded to a second oxygen atom (see figures 3.5 and 3.6). This

second oxygen is bonded to a short hydrocarbon chain on the other side. These short chains are usually one, two, or three carbons long. Because there are two carbon chains in an ester molecule, they usually have two-word names, the second word ending with the suffix –ate. Linalyl acetate, methyl-amyl angelate, benzyl acetate, bornyl acetate, neryl acetate, methyl thujate, and methyl salicylate are examples of monoterpene esters found in essential oils. Sesquiterpene esters are fairly uncommon in essential oils.

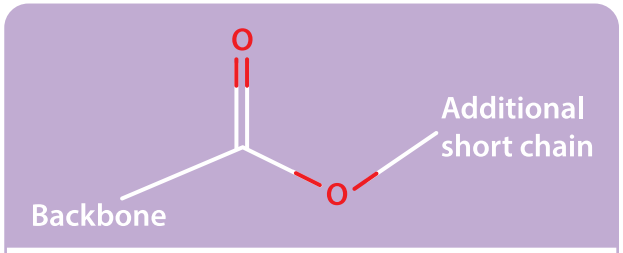


Figure 3.5: *An ester group*

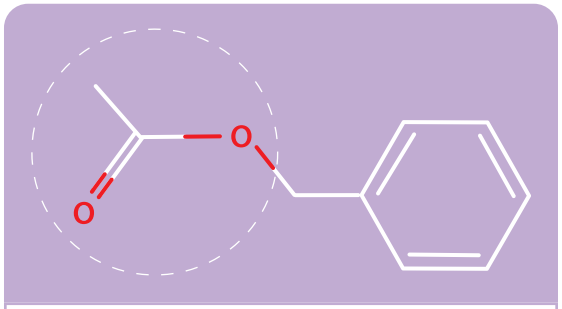


Figure 3.6: *An example of an ester group in the compound benzyl acetate, a main constituent of Jasmine absolute.*

Properties and Uses of Esters

Aromatic: Relaxing, soothing, balancing
Topical: Rejuvenate the skin, soothe the tissues, protect against certain kinds of environmental threats
Internal: Varies on a case-by-case basis. Some esters can support the health of the cardiovascular, immune, nervous, and digestive systems. Other esters are not recommended for internal consumption.*

Oils high in monoterpene esters: Lavender, Roman Chamomile, Helichrysum, Arborvitae, and Wintergreen

3.5 ETHERS

An ether is a molecule with an oxygen atom bonded between two carbons (see figures 12 and 13). In order to be an ether, the two flanking carbons must only have bonds with other carbons (or hydrogen). Ethers are sometimes found in the main carbon chain or in ring structures, appearing as if an oxygen had replaced a carbon in the backbone. They can also be found in the peripheral parts of some molecules. Ethers are not very common in monoterpenes. The monoterpene ether eucalyptol, also known as 1,8-cineole, is the most common ether found in essential oils. Anisole is another common monoterpene ether. Sesquiterpenes, on the other hand, are more likely to contain ether groups. For instance, curzerene and furanoeudsema-1,3-diene are two sesquiterpene ethers.

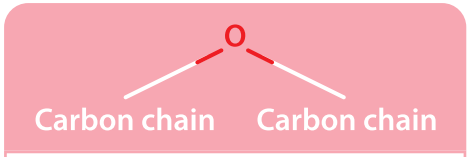


Figure 12: *An ether group*

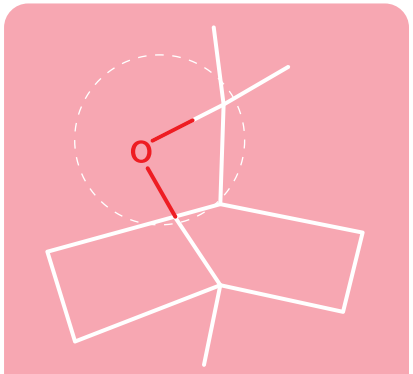


Figure 13: *An example of an ether group in the compound eucalyptol, the main constituent of Eucalyptus oil*

Properties and Uses of Ethers

Aromatic: Soothing to the emotions, promote feelings of clear airways
Topical: Surface cleaning properties, help improve the appearance of skin
Internal: Varies on a case-by-case basis. Some ethers provide antioxidant support and can also support proper immune system function.* Other ethers are not recommended for internal consumption.

Oils high in monoterpene ethers: Cardamom, Eucalyptus,

Rosemary, Melaleuca, and Peppermint

Oils high in sesquiterpene ethers: Myrrh and Vetiver

3.6 KETONES

A ketone is a molecule with a carbon atom double bonded to an oxygen atom **(see figures 3.7 and 3.8)**. The two carbons flanking this carbon must not be bonded to any atoms other than carbon (or hydrogen). Ketone molecules usually have names that end with the suffix –one. For instance, menthone and carvone are ketones. Camphor is also a notable ketone whose name doesn't follow the normal pattern. Many sesquiterpenes contain ketones. Jatamansone, rotundone, mustakone, faurinone, davanone, and leptospermone are the names of a few sesquiterpene ketones.

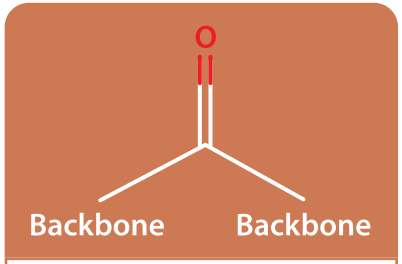


Figure 3.7: *An ketone group*

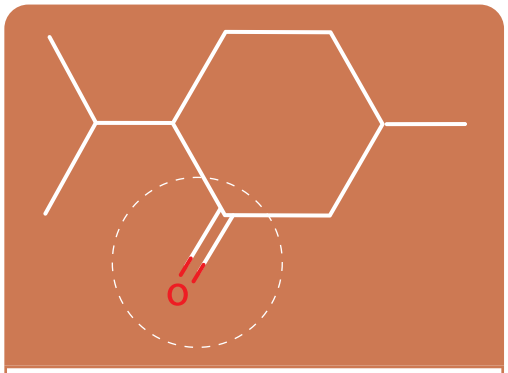


Figure 3.8: *An example of a ketone group found in Menthone, a constituent of Peppermint oil.*

Properties and Uses of Ketones

Aromatic: Some are energizing and uplifting, others are stabilizing and grounding. Certain ketones can support feelings of open airways.
Topical: repellant properties, may help keep the skin looking clean
Internal: Varies on a case-by-case basis. Most monoterpene ketones support digestive, gastrointestinal, and nervous system function and health.* Sesquiterpene ketones are generally not recommended for internal use.

Oils high in monoterpene ketones: Spearmint, Dill, Peppermint, Geranium, and Caraway

Oils high in sesquiterpene ketones: Spikenard, Frankincense

3.7 PHENOLS

Phenols are a special subtype of alcohols. A phenol is an alcohol group (an oxygen and a hydrogen) attached to a benzene ring **(see figures 3.9 and 3.10)**. A benzene ring has six carbon atoms arranged in a hexagon pattern and must have exactly three double bonds inside the ring. Because phenols are alcohols, their names also end with the suffix –ol. Thymol, carvacrol, and eugenol are the most common monoterpene phenols. Sesquiterpene phenols are fairly uncommon.

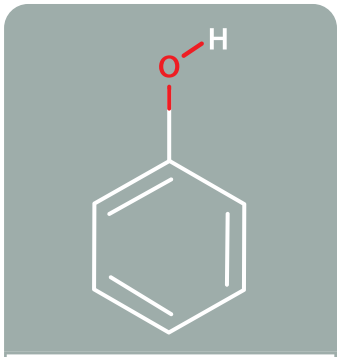


Figure 3.9: *An phenol group*

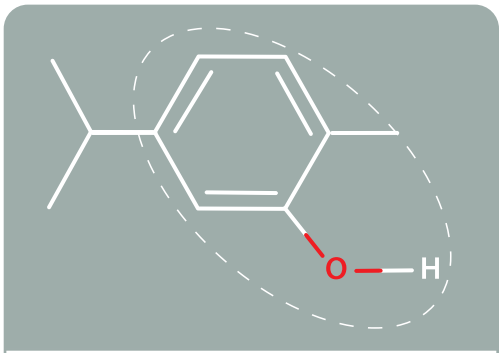


Figure 3.10: *An example of a phenol group in the compound carvacrol, the primary constituent of Oregano oil*

Properties and Uses of Phenols

Aromatic: Invigorating aroma
Topical: Powerful cleansing properties on skin and surfaces
Internal: Antioxidant properties, support the proper function of cardiovascular, circulatory, digestive, gastrointestinal, immune, nervous, and respiratory systems*

Oils high in monoterpene phenols: Thyme, Oregano, Clove, Cinnamon Bark, and Basil

3.8 PHENYLPROPENES

A phenylpropene group is characterized by a carbon in a benzene ring bonded to a second carbon that is then bonded to a third carbon with a double bond (see figures 3.11 and 3.12). The third carbon is single bonded to a fourth carbon at the end of the chain. Phenylpropenes are usually found in monoterpene compounds, but they are not common in most essential oils. Anethole and chavicol (also known as estragole) are the two most common phenylpropenes.

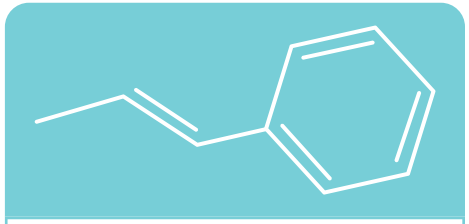


Figure 3.11: *A phenylpropene group*

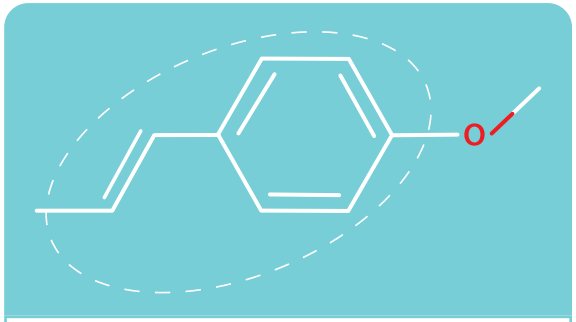


Figure 3.8: *An example of a phenylpropene group in the compound anethole, the primary constituent of Fennel oil. Note that anethole also has an ether group.*

Properties and Uses of Phenylpropenes

Aromatic: Energizing aroma
Topical: Support overall skin health and appearance
Internal: May support the cardiovascular system and promote healthy blood flow*

Oils high in monoterpene phenylpropenes: Fennel, Myrtle, Anise, Star Anise, and Basil

3.9 CONCLUSION

Now that you've learned about functional groups and the terpene backbone, you are ready to move on to Parts 2 and 3 of this book. Part 2 contains the most detailed chemical information publicly available on every single oil currently offered by dōTERRA. Each oil's functional group content, terpene content, and constituent composition is listed to help you characterize, compare, contrast, and categorize oils at your convenience. Part 3 contains detailed information on the chemical constituents mentioned in part 2. Part 3 details the usage and benefits of nearly a hundred different constituents and explains which oils those constituents can be found in, and in what quantities. While Part 1 was primarily focused on the general concepts underlying essential oil chemistry, the rest of this book contains detailed information on every dōTERRA oil and its chemical constituents.

PART 2: **A-Z OIL CHEMISTRY**

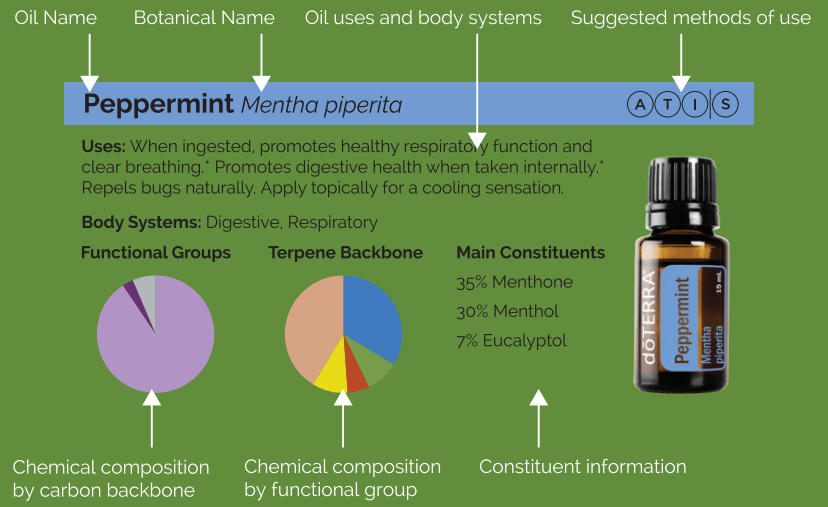
This part of the Oil Chemistry Handbook contains the most detailed chemical information publicly available on each of dōTERRA's single oils. The oil name and botanical name are both included in the header of each entry, with the suggested uses (Aromatic, Topical, and Internal) and skin sensitivity (Neat, Sensitive, or Dilute) on the right side of the header. The middle section of each entry contains information about the potential uses of each oil and the body systems it may support.

Below the uses and body systems are two pie graphs representing the chemical composition of each oil, one characterizing its functional group and the other giving information on the backbone composition. To the right of these pie charts is a list of the main constituents that consistently appear at levels at or above 5%. A percentage range indicates the possible values for the percent composition of constituent depending on the oil batch. Note that the percent composition of the main constituents often does not add up to 100%. This is because there are many additional compounds present in smaller amounts.

One limitation of the information given here is that it doesn't address the topic of chemical diversity. Unfortunately, this aspect of chemistry is impossible to convey in the form of a simple pie chart or a short list of constituents. For example, Spikenard and Myrrh are two incredibly diverse oils, each with potentially hundreds of different compounds. It would require many pages to list the names of all of their constituents. It is important to realize that the presence of these minor constituents can often give an oil additional benefits that are not associated with its main constituents. Because of synergy and the interaction between oil constituents, the benefits of the oils listed in this section may different than a simple sum of the benefits of their constituents taken from Part 3.

Another limitation is the ecological variance of oil composition. The exact percent of constituent composition in an essential oil depends on the geographical location, time of year, and even the time of day the plants are harvested. The composition of an essential oil isn't always identical to the percentages presented in this booklet. However, the percentages given here are considered standard, meaning that they represent the most likely composition for each oil. In fact, dōTERRA's staff of analytical chemists work hard to ensure that every batch of oil matches these standards within a reasonable margin.

We hope that you will enjoy having this valuable information at your fingertips as you browse this reference on essential oil chemistry.

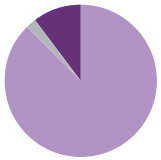


Arborvitae *Thuja Plicata* (A T N)

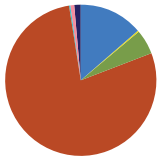
Uses: Protects against environmental and seasonal threats. Powerful cleansing and purifying agent. Natural insect repellent and wood preservative.

Body Systems: Immune, Skin

Carbon backbone



Functional groups



Main Constituents

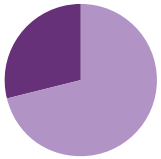
50–70% Methyl thujate

Basil *Ocimum Basilicum* (A T I N)

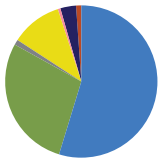
Uses: Apply topically to help keep the skin looking clean, clear, and healthy. Diffuse to promote mental alertness and lessen anxious feelings. Take internally to help to ease monthly feminine discomfort.*

Body Systems: Nervous, Reproductive, Skin

Carbon backbone



Functional groups



Main Constituents

40-80% Linalool

1–15% 1,8-Cineole (eucalyptol)

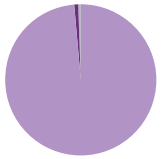
1–7% Bergamotene

Bergamot *Citrus Bergamia* (A T I S)

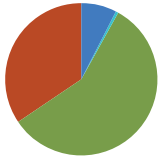
Uses: Diffuse for a calming and soothing aroma. Provides skin purifying benefits. Frequently used in massage therapy for its calming benefits.

Body Systems: Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

20–55% Limonene
10–45% Linalyl acetate
3–12% gamma-Terpinene
3–20% Linalool
3–12% beta-Pinene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

*These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease.

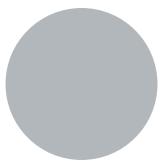
*Statements marked with asterisks refer to internal use only. Some essential oils containing the compounds presented are not recommended for internal use.

Birch *Betula lenta* (A T S)

Uses: Provides a soothing massage and cooling sensation after exercise. Promotes healthy-looking skin. Apply topically to reduce appearance of blemishes.

Body Systems: Nervous, Skin, Musculoskeletal

Carbon backbone



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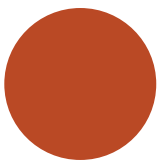


Main Constituents

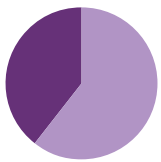
> 98% Methyl salicylate

Black Pepper *Piper nigrum* (A T I S)

Uses: Provides antioxidant support, supports healthy circulation, and aids digestion. Enhances food flavor. Diffuse to soothe anxious feelings.

Body Systems: Nervous, Cardiovascular, Digestive

Carbon backbone



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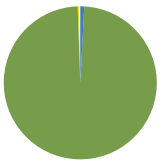


Main Constituents

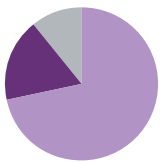
8–46% Beta-caryophyllene
9–25% Limonene
0.1–23% Sabinene
2–20% beta-Pinene
1–20% alpha-Pinene
0.01–21% delta-3-Carene

Blue Tansy *Tanacetum Anuum* (A T N)

Uses: Helps reduce the appearance of blemishes. Provides a soothing sensation when applied to the skin.

Body Systems: Skin

Carbon backbone



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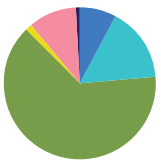

Main Constituents

2–15% Chamazulene
10–30% Sabinene
5–20% Camphor
2–10% beta-Pinene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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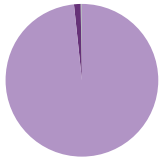
Cardamom *Eletarria cardamomum* (A T I N)

Uses: May help ease indigestion and maintain overall gastrointestinal health.* Promotes clear breathing and respiratory health. Flavorful spice for cooking and baking.

Body Systems: Digestive, Respiratory

Carbon backbone



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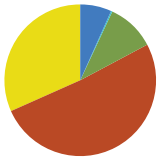


Main Constituents

25–50% Terpinyl acetate

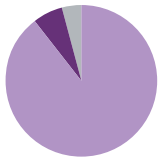
25–50% 1,8-Cineole (eucalyptol)

Cassia *Cinnamomum cassia* (A T I D)

Uses: Promotes healthy digestion when taken internally.* Ingest to support healthy cardiovascular, metabolic, and immune function.* Possesses a warming, uplifting aroma.

Body Systems: Cardiovascular, Digestive, Endocrine, Immune

Carbon backbone



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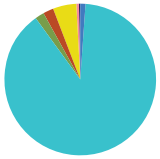


Main Constituents

75-97% Cinnamaldehyde

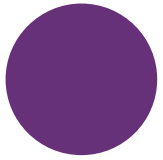
1-8% Cinnamyl acetate

Cedarwood *Juniperus virginiana* (A T I S)

Uses: Naturally repels insects. Promotes relaxation. Helps to keep skin looking healthy.

Body Systems: Nervous, Skin

Carbon backbone



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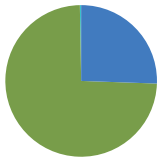

Main Constituents

10–47% alpha-Cedrene

9–40% Cedrol

7–30% Thujopsene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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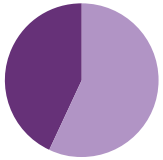
Cilantro *Coriandrum sativum* (A T I N)

Uses: Supports healthy digestion when taken internally.* Powerful cleanser and detoxifier.* Gives food a fresh and tasty flavor.

Body Systems: Digestive

Carbon backbone



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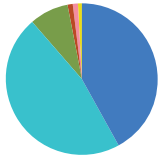


Main Constituents

15–45% 2-Decenal

5–25% 2-Decenol

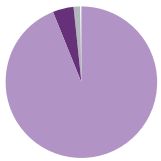
10–35% Linalool

Cinnamon Bark *Cinnamomum zeylanicum* (A T I D)

Uses: Supports healthy metabolic function.* Maintains a healthy immune system.* Naturally repels insects. Long used to flavor food and for its internal health benefits.

Body Systems: Endocrine, Immune

Carbon backbone



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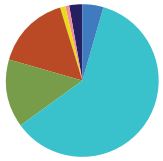


Main Constituents

45-80% Cinnamaldehyde

2-15% Cinnamyl acetate

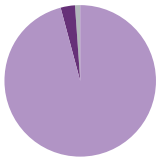
1-10% Eugenol

Clary Sage *Salvia sclarea* (A T I N)

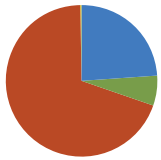
Uses: Promotes healthy-looking hair and scalp. Promotes a restful night's sleep. Calming and soothing to the skin.

Body Systems: Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

40–75% Linalyl acetate

8–40% Linalool

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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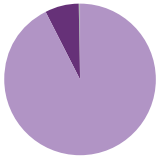
*Statements marked with asterisks refer to internal use only. Some essential oils containing the compounds presented are not recommended for internal use.

Clove *Eugenia caryophyllata* (A T I D)

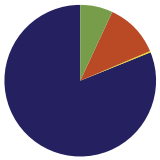
Uses: Powerful antioxidant properties.* Supports cardiovascular health.* Helps clean teeth and gums.

Body Systems: Cardiovascular

Carbon backbone



Functional groups



Main Constituents

63–95% Eugenol

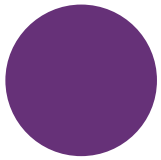
0.6–20% beta-Caryophyllene

Copaiba *Copaifera spp.* (A T I D)

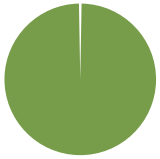
Uses: Supports the health of the cardiovascular, immune, digestive and respiratory systems.* Powerful antioxidant.* Helps calm and soothe the nervous system.* Promotes clear skin and reduces the appearance of blemishes.

Body Systems: Cardiovascular, Digestive, Immune, Nervous, Respiratory, Skin

Carbon backbone



Functional groups



Main Constituents

45–65% beta-Caryophyllene

2–12% Bergamotene

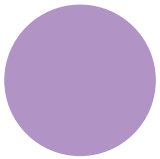
2–12% Copaene

Coriander *Coriandrum sativum* (A T I N)

Uses: Promotes digestion.* Helps maintain a clear complexion. Promotes relaxation.

Body Systems: Digestive, Nervous, Skin

Carbon backbone



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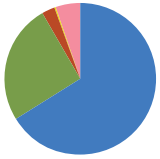


Main Constituents

60–75% Linalool

5–20% alpha-Pinene

2–8% Camphor

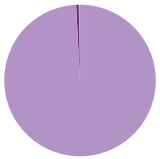
0.1-10% gamma-Terpinene

Cumin *Cuminum cyminum* (A T I S)

Uses: Supports digestive health and helps to relieve occasional digestive discomfort.* Purifying to the body's systems.*

Body Systems: Digestive, Cardiovascular, Skin

Carbon backbone



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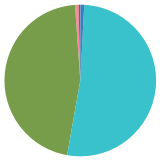


Main Constituents

10–40% Cuminal

1–35% Terpinen-7-al

3–35% gamma-Terpinene

4–35% beta-Pinene

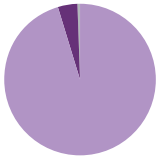
3–20% p-Cymene

Cypress *Cupressus sempervirens* (A T N)

Uses: Promotes vitality and energy. Helps improve the appearance of oily skin.

Body Systems: Nervous, Skin

Carbon backbone



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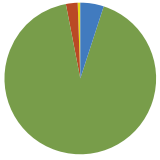


Main Constituents

20–65% alpha-Pinene

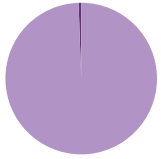
7–30% delta-3-Carene

Dill *Anethum graveolens* (A T I N)

Uses: Supports digestion and overall gastrointestinal health.* Provides powerful antioxidant protection.* Purifying to the body's systems.* Promotes restful sleep.*

Body Systems: Digestive, Nervous

Carbon backbone



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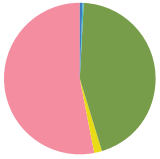

Main Constituents

40–65% Carvone

30–55% Limonene

0.5–6% alpha-Phellandrene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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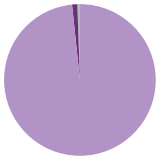
Douglas Fir *Pseudotsuga menziesii* (A T N)

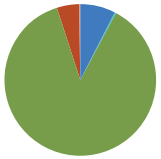
Uses: Promotes feelings of clear airways and easy breathing. Cleansing and purifying to the skin. Promotes a positive mood and sense of focus.

Body Systems: Nervous, Respiratory, Skin

Carbon backbone



Functional groups



Main Constituents

20–40% beta-Pinene

5–25% Sabinene

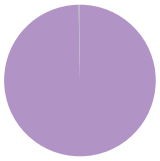
5–25% Terpinolene

Eucalyptus *Eucalyptus radiata* (A T S)

Uses: Helps to clear the mind. Promotes feelings of relaxation. Promotes feelings of clear breathing.

Body Systems: Nervous, Respiratory

Carbon backbone



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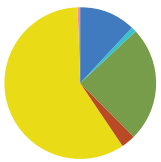


Main Constituents

55–85% 1,8-cineole (eucalyptol)

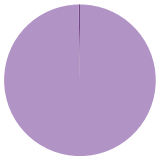
1–15% Terpineol

Fennel *Foeniculum vulgare* (A T I S)

Uses: Promotes healthy digestion.* Supports a healthy respiratory system.* May help promote healthy metabolism, liver function, and circulation.*

Body Systems: Cardiovascular, Digestive, Endocrine, Respiratory

Carbon backbone



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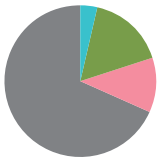

Main Constituents

50–90% Anethole

1-20% Fenchone

1-15% alpha-Pinene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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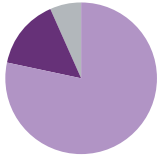
Frankincense *Boswellia spp.* (A T I N)

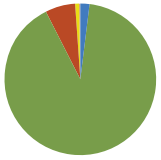
Uses: Ingest to support healthy cellular function.* Aroma promotes feelings of relaxation. Helps reduce the appearance of skin imperfections when applied topically. Supports healthy immune, nervous, and digestive function when taken internally.*

Body Systems: Nervous, Digestive, Immune, Skin

Carbon backbone



Functional groups



Main Constituents

25–65% alpha-Pinene

5–20% Limonene

0.1–10% beta-Caryophyllene

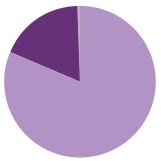
0.1-10 % alpha-Thujene

Geranium *Pelargonium graveolens* (A T I S)

Uses: Promotes the appearance of clear, healthy skin. Naturally repels insects. Gives hair a vibrant, healthy glow.

Body Systems: Immune, Skin

Carbon backbone



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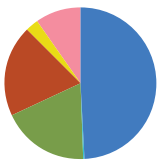


Main Constituents

30–45% Citronellol

1–15% Citronellyl formate

0.5–10% Guaiadene

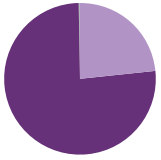
5–25% Geraniol

Ginger *Zingiber officinale* (A T I S)

Uses: May help to support healthy digestion.* May help to reduce bloating, gas, and occasional indigestion.* May help reduce occasional nausea.*

Body Systems: Digestive

Carbon backbone



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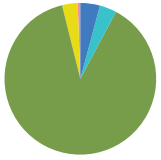

Main Constituents

20–40% Zingiberene

5–20% Sesquiphellandrene

1–10% Camphene

0.1–10% Curcumene

0.1–10% Bisabolene

0.1–10% Farnesene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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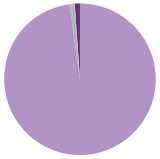
Grapefruit *Citrus X paradisi*

A T I N

Uses: Improves the appearance of blemishes. Supports healthy metabolism.* Uplifts mood.

Body Systems: Endocrine, Nervous, Skin

Carbon backbone



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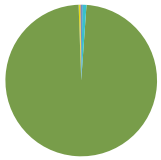


Main Constituents

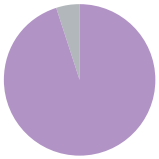
90–97% Limonene

Green Mandarin *Citrus reticulata*

A T I N

Uses: May be used aromatically to uplift mood, cleanse the air and provide a refreshing, light aroma. Can be used to flavor food and beverages. May help to support healthy cardiovascular, digestive, immune, metabolic, and nervous system health when taken internally.*
Body Systems: Cardiovascular, Digestive, Endocrine, Immune, Nervous, Respiratory, Skin

Carbon backbone



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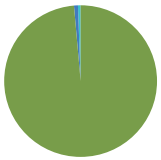


Main Constituents

63-85% Limonene

8-25% gamma-Terpinene

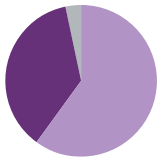
Helichrysum *Helichrysum italicum*

A T I N

Uses: Helps skin look young and healthy. May help promote a healthy metabolism.*

Body Systems: Endocrine, Skin

Carbon backbone



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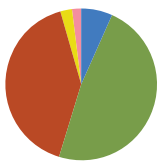

Main Constituents

25–50% Neryl acetate

2–20% Curcumene

5–20% alpha-Pinene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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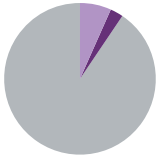
Jasmine *Jasminum grandiflorum*

A T I N

Uses: Promotes a healthy-looking, glowing complexion. Nourishes and protects the skin and scalp.

Body Systems: Skin

Carbon backbone



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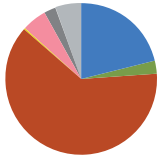


Main Constituents

3–50% Phytol
5–25% Phytol acetate
5–25% Benzyl acetate
0.1-10% Benzyl benzoate

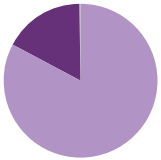
Juniper Berry *Juniperus communis*

A T I N

Uses: Supports healthy kidney and urinary tract function.*Acts as a natural skin toner and a natural cleansing and detoxifying agent.* Has a calming, grounding effect.

Body Systems: Skin, Urinary

Carbon backbone



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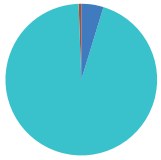


Main Constituents

24–55% alpha-Pinene

0.0–25% Myrcene

0.0–30% Sabinene

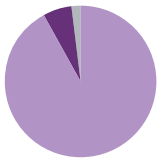
Lavender *Lavandula angustifolia*

A T I N

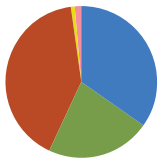
Uses: Soothes occasional skin irritations. When taken internally, Lavender reduces anxious feelings and promotes peaceful sleep.* Helps ease feelings of tension.*

Body Systems: Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

25–45% Linalyl acetate

20–47% Linalool

0.3–10% Ocimene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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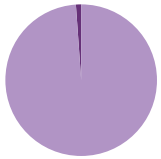
Lemon *Citrus limon* (A T I N)

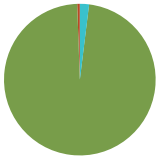
Uses: Cleanses and purifies the air and surfaces. Naturally cleanses the body and aids in digestion.* Supports healthy respiratory function.* Promotes a positive mood.

Body Systems: Digestive, Respiratory, Immune, Skin

Carbon backbone



Functional groups



Main Constituents

55–75% Limonene

6–18% beta-Pinene

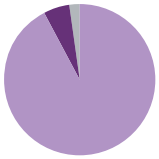
3–16% gamma-Terpinene

Lemongrass *Cymbopogon flexuosus* (A T I S)

Uses: Supports healthy digestion when taken in a capsule.* Natural insect repellent. Protects against certain environmental threats.

Body Systems: Digestive, Immune

Carbon backbone



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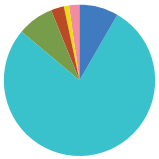


Main Constituents

25–50% Neral

25–50% Geranial

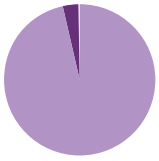
1–15% Geraniol

Lime *Citrus aurantifolia* (A T I S)

Uses: Supports healthy immune function.* Used as an aromatic, topical, and internal cleanser.* Natural degreaser and surface cleanser.

Body Systems: Digestive, Immune

Carbon backbone



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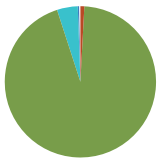

Main Constituents

40–70% Limonene

5–20% gamma-Terpinene

10–25% beta-Pinene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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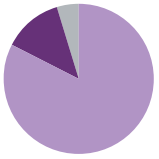
Magnolia *Michelia x alba* (A T N)

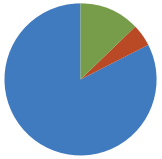
Uses: Diffuse to promote feelings of relaxation. Can help soothe the skin when applied topically.

Body Systems: Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

50-80% Linalool

1-10% beta-Carophyllene

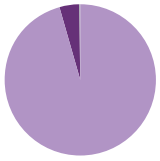
.1-5%Germacrene D

Marjoram *Origanum majorana* (A T I N)

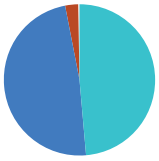
Uses: Valued for its calming properties and positive effect on the nervous system when taken internally.* Supports a healthy immune system when consumed.* May promote a healthy cardiovascular system when ingested.*

Body Systems: Cardiovascular, Immune, Nervous

Carbon backbone



Functional groups



Main Constituents

0.1–55% Terpinene-4-ol

0.5–20% gamma-Terpinene

0.4–33% Sabinene-hydrate

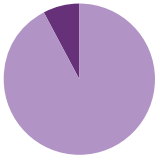
0.1 -20% Sabinene

Melaleuca *Melaleuca alternifolia* (A T N)

Uses: Renowned for its cleansing and rejuvenating effect on the skin. Promotes healthy immune function when used internally.* Ingest to protect against environmental and seasonal threats.*

Body Systems: Immune, Skin

Carbon backbone



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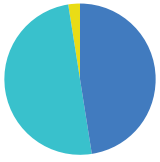

Main Constituents

20–60% Terpinen-4-ol

10–55% Terpinene (alpha and gamma)

1–10% alpha-Pinene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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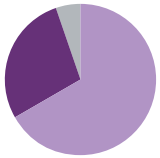
Melissa *Melissa officinalis* (A T I N)

Uses: May help to support a healthy immune system.* Calms tension and nerves. Promotes feelings of relaxation.

Body Systems: Immune, Nervous

Carbon backbone



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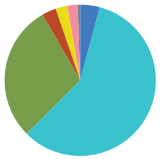


Main Constituents

10–47% Geranial

1–32% Neral

1–22% beta-Caryophyllene

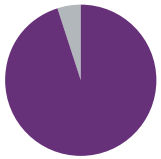
1-25% Germacrene D

Myrrh *Commiphora myrrha* (A T I N)

Uses: Powerful cleansing properties, especially for the mouth and throat. Soothing to the skin; promotes a smooth, youthful-looking complexion. Promotes emotional balance and well-being when diffused.

Body Systems: Digestive, Nervous, Skin*

Carbon backbone



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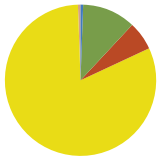


Main Constituents

15–45% Curzerene

15–45% Fura-noeudesma-1,3-diene

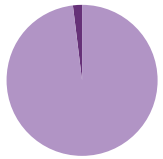
1–20% Lindestrene

Oregano *Origanum vulgare* (A T I D)

Uses: Used as a powerful cleansing and purifying agent. Supports a healthy immune system, healthy digestion, and respiratory function when used internally.* Offers powerful antioxidants when ingested.*

Body Systems: Digestive, Immune, Respiratory

Carbon backbone



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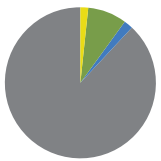

Main Constituents

60–80% Carvacrol

0.5–10% Thymol

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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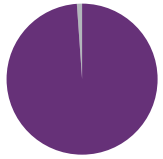
Patchouli *Pogostemon cablin* (A T I N)

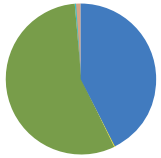
Uses: Grounding, balancing effect on emotions. Promotes a smooth, glowing complexion. Reduces the appearance of wrinkles, blemishes, and skin imperfections.

Body Systems: Skin, Nervous

Carbon backbone



Functional groups



Main Constituents

20–40% Patchoulol

1–20% Bulnesene

2–25% Aromaden-drene

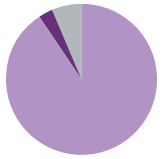
2-25% Guiaene

Peppermint *Mentha piperita* (A T I S)

Uses: When ingested, promotes healthy respiratory function and clear breathing.* Promotes digestive health when taken internally.* Repels bugs naturally. Apply topically for a cooling sensation.

Body Systems: Digestive, Respiratory

Carbon backbone



Functional groups

Main Constituents

10–30% Menthone

20–60% Menthol

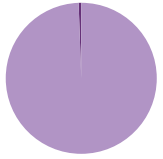
1-10% 1,8-Cineole (eucalyptol)

Petitgrain *Citrus aurantium* (A T I S)

Uses: May help support healthy cardiovascular function.* May provide antioxidant support* Supports healthy immune function.* May help promote a restful sleep*

Body Systems: Cardiovascular, Immune, Nervous

Carbon backbone



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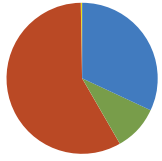

Main Constituents

40–65% Linalyl acetate

15–30% Linalool

1–12% Terpineol

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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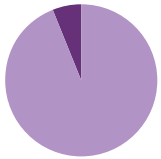
Pink Pepper *Schinus molle* (A T I N)

Uses: Create a soothing massage by combining one to two drops with dōTERRA Fractionated Coconut Oil. Diffuse or inhale directly to promote feelings of alertness. May help to calm and soothe the nervous system when taken internally.*

Body Systems: Cardiovascular, Digestive, Immune, Nervous, Respiratory

Carbon backbone



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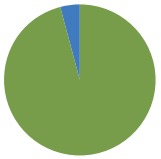


Main Constituents

5-35% alpha-Phellandrene

5-35% Myrcene

.1-10% beta-Caryophyllene

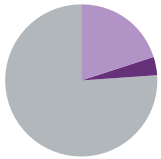
.05-5% Cadinene <delta>

Roman Chamomile *Anthemis nobilis* (A T I N)

Uses: Has a calming effect on the skin, mind, and body.* May help support healthy immune system function.*

Body Systems: Immune, Nervous, Skin

Carbon backbone



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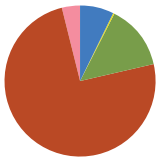


Main Constituents

5–40% 4-Methylamyl angelate

5–40% Isoamyl tiglate

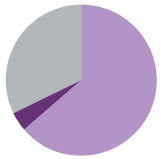
5–40% Isobutyl angelate

Rose *Rosa damascena* (A T N)

Uses: Helps balance moisture levels in the skin. Reduces the appearance of skin imperfections. Promotes an even skin tone and healthy complexion. Emotionally uplifting aroma.

Body Systems: Nervous, Skin

Carbon backbone



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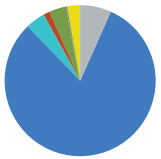

Main Constituents

20–40% Citronellol

10–30% Geraniol

5–15% Nerol

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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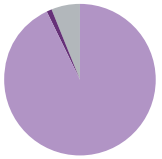
Rosemary *Rosmarinus officinalis* (A T I N)

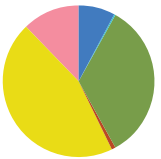
Uses: Supports healthy digestion.* Supports healthy respiratory function.* Helps reduce nervous tension and occasional fatigue.*

Body Systems: Digestive, Nervous, Respiratory

Carbon backbone



Functional groups



Main Constituents

30–60% 1,8-Cineole (eucalyptol)

5–15% Camphor

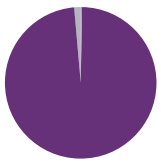
5–20% alpha-Pinene

Sandalwood (Hawaiian) *Santalum paniculatum* (A T N)

Uses: Promotes healthy looking, smooth skin. Reduces the appearance of skin imperfections. Enhances mood. Frequently used in meditation for its grounding and uplifting properties.

Body Systems: Nervous, Skin

Carbon backbone



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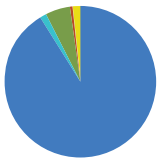


Main Constituents

10–60% Santalol (alpha and beta)

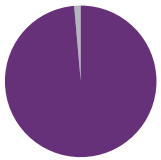
2–16% Lanceol

Sandalwood (Indian) *Santalum album* (A T N)

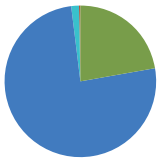
Uses: Promotes healthy looking, smooth skin. Reduces the appearance of scars and skin imperfections. Enhances mood. Frequently used in meditation for its grounding and uplifting properties.

Body Systems: Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

10–60% Santalol (alpha and beta)

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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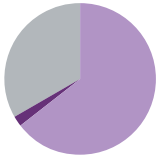
Siberian Fir *Abies sibirica* (A T I N)

Uses: Helps balance emotions and soothe anxious feelings. Diffuse for a relaxing aroma. Provides a soothing effect when used in massage.

Body Systems: Musculoskeletal, Nervous, Skin

Carbon backbone



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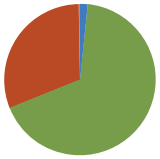


Main Constituents

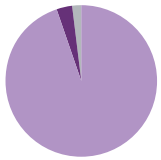
20–40% Bornyl acetate
10–30% delta-3-Carene
5–20% alpha-Pinene

Spearmint *Mentha spicata* (A T I S)

Uses: Promotes digestion and helps reduce occasional stomach upset.* Promotes a sense of focus and uplifts mood. Cleanses the mouth and promotes fresh breath.

Body Systems: Digestive, Nervous

Carbon backbones



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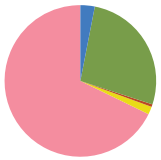


Main Constituents

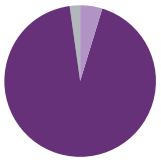
20–80% Carvone
5–30% Limonene

Spikenard *Nardostachys jatamansi* (A T N)

Uses: Uplifting aroma. Promotes feelings of calmness and relaxation. Frequently used in aromatherapy and meditation for its grounding properties. Purifying to the skin.

Body Systems: Nervous, Skin

Carbon backbone



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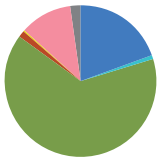

Main Constituents

3–13% Gurjunene
3–20% Jatamansone
2–15% Spirojatamol

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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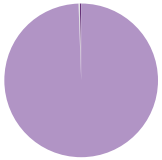
Tangerine *Citrus reticulata* (A T I D)

Uses: Skin clearing agent, promote mental alertness, soothe anxious feelings.*

Body Systems: Cardiovascular, Immune, Nervous, Skin*

Carbon backbone



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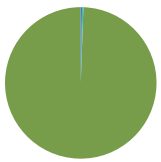


Main Constituents

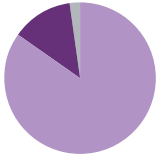
80–99% Limonene
0.5–8% Myrcene

Thyme *Thymus vulagris* (A T I D)

Uses: Provides powerful antioxidants.* Supports a healthy immune system.* Naturally repels insects.

Body Systems: Immune

Carbon backbone



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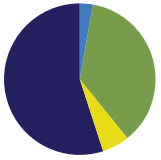


Main Constituents

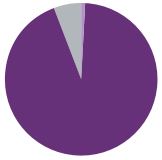
30–66% Thymol
3–35% p-Cymene
0.2–16% Carvacrol
0.1–15% beta-Caryophyllene

Turmeric *Curcuma longa* (A T I N)

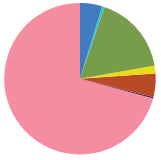
Uses: Provides antioxidant support when taken internally.* Promotes healthy circulation, gastrointestinal function, metabolism, and cellular function when taken internally.* Supports healthy immune and nervous system function.* Promotes a clean and healthy mouth. Topical use of turmeric essential oil may support clean and healthy looking skin and reduce the appearance of blemishes..

Body Systems: Cardiovascular, Digestive, Immune, Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

15-50% Ar-Tumerone
8-30% Tumerone
0.1-15% Zingiberene <alpha>

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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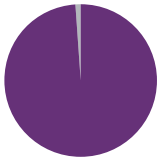
Vetiver *Vetivera zizanioides* (A T I N)

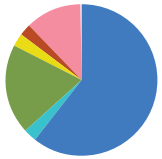
Uses: Calming, grounding effect on emotions. Immune-supporting properties.*

Body Systems: Immune, Nervous

Carbon backbone



Functional groups



Main Constituents

5–15% Khusimol

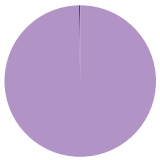
5–20% Isovalencenol

Wild Orange *Citrus sinensis* (A T I N)

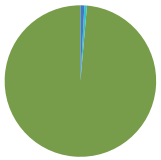
Uses: Powerful cleanser and purifying agent. Supports healthy immune function.* Uplifting to the mind and body.

Body Systems: Immune, Nervous

Carbon backbone



Functional groups



Main Constituents

80–97% Limonene

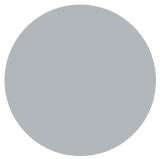
0.5–5% Myrcene

Wintergreen *Gaultheria fragrantissima* (A T S)

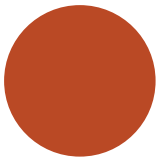
Uses: Great for a warming soothing massage after exercise. Has a refreshing aroma that's uplifting and stimulating. Frequently used in gum, candy, and toothpaste for flavoring.

Body Systems: Musculoskeletal, Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

>98% Methyl salicylate

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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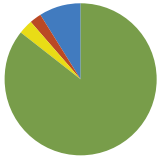
Yarrow *Achillea millefolium* (A T I N)

Uses: When taken internally, may promote cellular, immune and nervous system health.* May be diluted in moisturizer or facial cleanser and applied topically to reduce the appearance of blemishes. Can be diffused to uplift mood.

Body Systems: Immune, Nervous, Skin

Carbon backbone

Functional groups



Main Constituents

10-25% Sabinene

5-20% beta-Caryophyllene

10-25% Germacrene D

2-10% Chamazulene

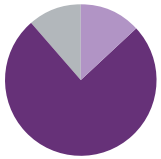
10-30% beta-Pinene

Ylang Ylang *Cananga odorata* (A T I N)

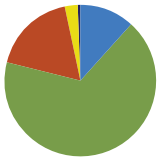
Uses: Provides antioxidant support.* Promotes appearance of healthy skin and hair. Lifts mood while having a calming effect.

Body Systems: Nervous, Skin

Carbon backbone



Functional groups



Main Constituents

10–30% Germacrene D

5–25% beta-caryophyllene

5–15% Farnesene

Legend: Monoterpene, Sesquiterpene, Other, Alcohol, Aldehyde, Alkene, Ester, Ketone, Phenylpropene, Phenol, Ether

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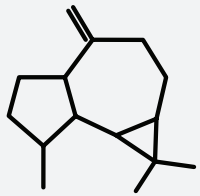
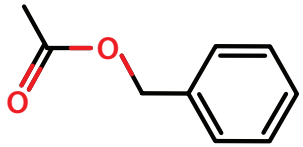
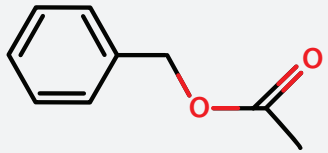
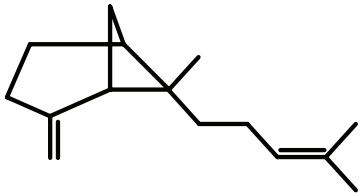
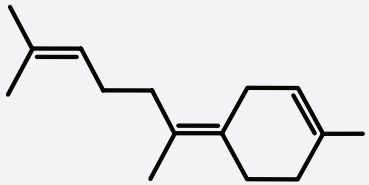
PART 3: **ESSENTIAL OIL CONSTITUENTS**

This portion of the Oil Chemistry Handbook presents the chemical properties of around 80 of the main chemical constituents found in dōTERRA oils. The name, structure, chemical classification, uses, and benefits of each compound are listed along with the oils in which these compounds can be found, and in what percent composition. This section is designed to serve as an expansion of the constituent details provided in the dōTERRA Oil Chemistry Wheel.

It is important to realize that this section of the handbook only highlights the most abundant essential oil constituents. In reality, there are hundreds of different monoterpene compounds and over 10,000 different kinds of sesquiterpenes. While most oils are mainly composed of just a few of the compounds listed in Part 3, many oils contain close to a hundred other minor constituents present in small quantities. Interestingly, these minor constituents can make a major contribution to an oil's properties. Synergistic effects between minor constituents can also play an important role in how the oil interacts with the body and other substances. The scientific consensus from the current research is that an oil is much more than the sum of its main compounds. This means that the benefits of an essential oil may be different than the simple sum of the benefits of its constituents.

Knowing the main constituents in an oil can help you determine how it fits into a daily usage model and how it can be compared to other oils. An oil with high levels of a certain constituent will likely have the properties of that constituent. If a given constituent is useful in a certain context, another oil also containing that constituent would probably be useful in the same context. These principles are the basis of the framework that we hope you can take from the information contained in this section of the Oil Chemistry Handbook.

Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
Anethole		Phenylpropene	• Supports digestive system* • Helps maintain healthy cellular function* • Supports healthy blood flow * • Soothing to the tissues.	Fennel 50-90%
Aromadendrene		Sesquiterpene Alkene	• Surface cleansing properties • Synergizes with1,8-cineole (eucalyptol) to create a potent cleanser	Patchouli 2-25%
Benzyl acetate		Ester	Sweet aroma reminiscent of apple or pear	Jasmine 5-25%
Benzyl benzoate		Ester	• Insect repellent • May promote feelings of open airways	Jasmine 0.1-15%
Bergamotene		Sesquiterpene Alkene	Antioxidant*	• Copaiba 2-12% • Basil 1-7%
Bisabolene		Sesquiterpene Alkene	• Supports healthy cellular function * • Posesses a balsamic odor.	Ginger 0.1-10%

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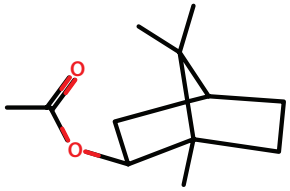
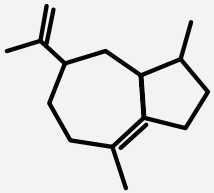
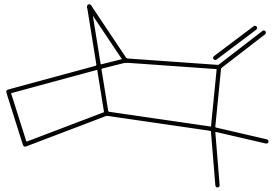
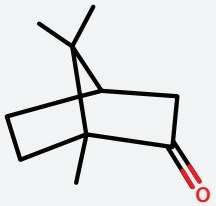
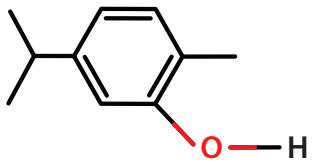
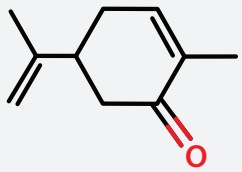
Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
Bornyl acetate		Monoterpene Ester	• Supports feelings of moist airways • Soothes the tissues • Posesses a calming aroma that soothes anxious feelings • Supports cellular function and the immune system*	Siberian Fir 20-40%
Bulnesene		Sesquiterpene Alkene	May support healthy blood flow*	Patchouli 1-20%
Camphene		Monoterpene Alkene	Antioxidant*	• Siberian Fir 10-30% • Ginger 1-10%
Camphor		Monoterpene Ketone	Can help in a soothing massage for muscle aches	• Blue Tansy 5-20% • Rosemary 5-15% • Coriander 2-8%
Carvacrol		Monoterpene Phenol	• Powerful surface cleansing properties • Soothes the skin; Provides antioxidants* • Supports liver function and the digestive, nervous, cardiovascular, and musculoskeletal systems* • Supports cellular health *	• Oregano 60-80% • Thyme 0.2-16%
Carvone		Monoterpene ketone	Soothing effect on the tissues and on the entire body*	• Spearmint 20-80% • Dill 40-65%

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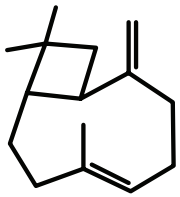
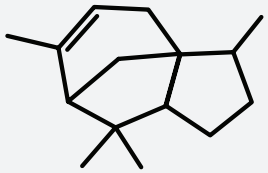
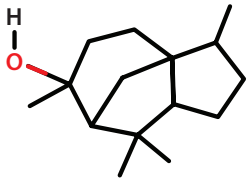
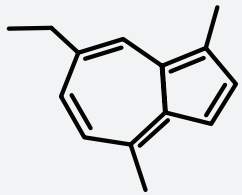
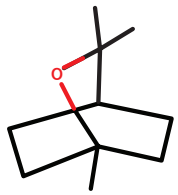
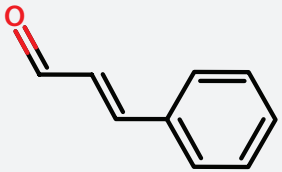
Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
beta-Caryophyllene		Sesquiterpene Alkene	• Soothing to the skin and tissues • May reduce the appearance of blemishes • Supports a healthy inflammatory response* • Strong antioxidant* • Supports the digestive and circulatory systems*	• Copaiba 45-65% • Black Pepper 8-46% • Ylang Ylang 5-25% • Melissa 1-22% • Clove 0.6-20% • Thyme 0.1-15% • Frankincense 0.1-10%
alpha-Cedrene		Sesquiterpene Alkene	Surface cleansing properties	Cedarwood 10-47%
Cedrol		Sesquiterpene Alcohol	Calming and relaxing aroma	Cedarwood 9-40%
Chamazulene		Alkene	• Soothing to the tissues; Supports cellular health* • Supports immune and nervous system health*	Blue Tansy 2-15%
1,8-Cineole (eucalyptol)		Monoterpene Ether	• Surface cleansing properties • May support healthy respiratory system function*	• Eucalyptus 55-85% • Rosemary 30-60% • Cardamom 25-50% • Basil 1-15% • Peppermint 1-10%
Cinnamal-dehyde		Aldehyde	• Powerful antioxidant* • Supports cellular, liver, brain, and kidney health* • Promotes the functions of the digestive, nervous, and circulatory systems *	• Cassia 75-97% • Cinnamon 45-80%

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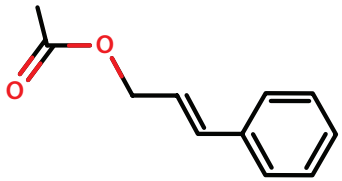
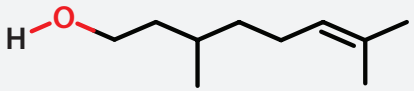
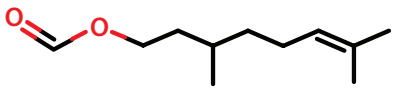
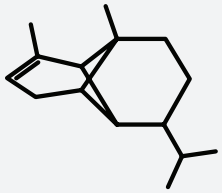
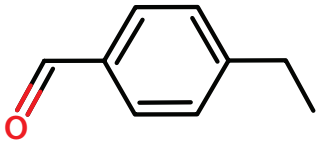
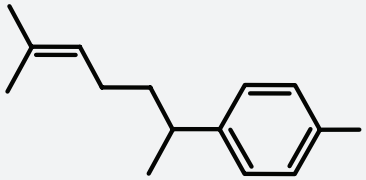
Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
Cinnamyl acetate		Ester	May help maintain health of the colon and gastrointestinal tract *	• Cinnamon 2-15% • Cassia 1-8%
Citronellol		Monoterpene Alcohol	• Supports cellular function and response* • Promotes healthy blood flow * • Topical application may help the skin and scalp look clean and healthy; Can keep pesky insects at bay	• Geranium 30-45% • Rose 20-40%
Citronellyl formate		Monoterpene Ester	Surface cleansing properties	Geranium 1-15%
Copaene		Sesquiterpene Alkene	Antioxidant*	Copaiba 2-12%
Cuminal		Aldehyde	May help support and maintain healthy blood glucose levels already in the normal range*	Cumin 10-40%
Curcumene		Sesquiterpene Alkene	Internally cleansing*	• Helichrysum 2-20% • Ginger 0.1-10%

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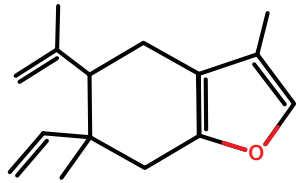
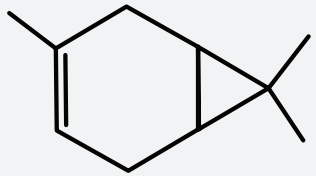
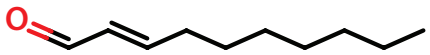
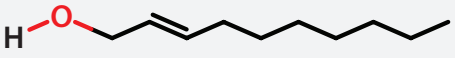
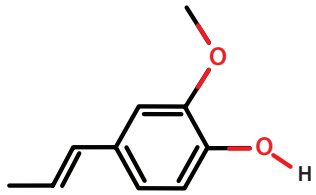
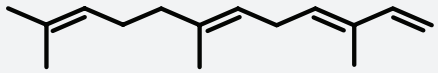
Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
Curzerene		Sesquiterpene Ether	• Surface cleansing properties • May support healthy cellular function *	Myrrh 15-35%
delta-3-Carene		Monoterpene Alkene	Surface cleansing properties	• Cypress 7-30% • Siberian Fir 5-20% • Black Pepper 0.01-21%
2-Decenal		Aldehyde	Surface cleansing properties	Cilantro 15-45%
2-Decenol		Alcohol	Fragrant aroma	Cilantro 5-25%
Eugenol		Phenol/ Phenylpropanoid	• May help keep mouth and teeth clean • May provide antioxidant properties* • May promote healthy immune response* • Supports cellular and cardiovascular health*	• Clove 63-95% • Cinnamon Bark 1-10%
Farnesene		Sesquiterpene Alkene	May support cellular health *	• Ylang Ylang 5-15% • Ginger 0.1-10%

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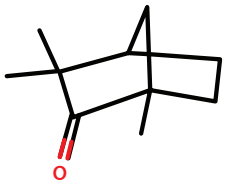
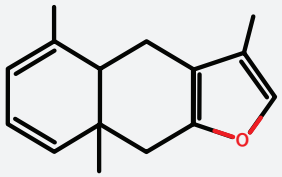
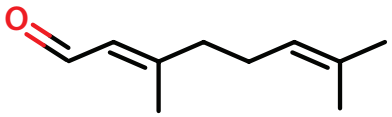
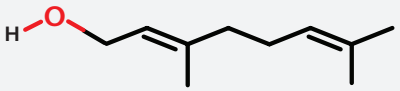
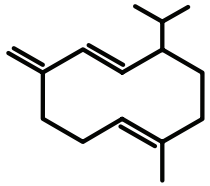
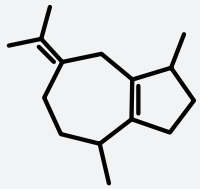
Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
Fenchone		Monoterpene Ketone	May support skin health*	Fennel 1-20%
Furanoeud-esma 1,3-diene		Sesquiterpene Ether	• Surface cleansing properties • May support calming and relaxation due to effects on central nervous system*	Myrrh 15-45%
Geranial		Monoterpene Aldehyde	• Surface cleansing properites • May support healthy cellular function • Promotes healthy cholesterol levels already in the normal range and hormonal balance* • Calms and soothe muscles* • Supports healthy cognitive and immune system function*	• Lemongrass 25-50% • Melissa 10-47%
Geraniol		Monoterpene Alcohol	• Surface cleansing properties • Supports cellular health* • Supports nervous system and digestive tract health *	• Rose 10-30% • Geranium 5-25% • Lemongrass 1-15%
Germacrene D		Sesquiterpene Alkene	• May provide antioxidant support* • Supports healthy cellular function*	• Ylang Ylang 10-30% • Melissa 1-25%
Guaiene		Sesquiterpene Alkene	• Soothing properties • Surface cleansing properties	Patchouli 2-25%

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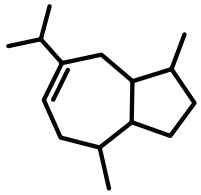
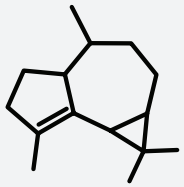
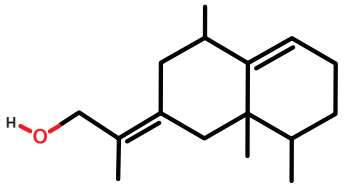
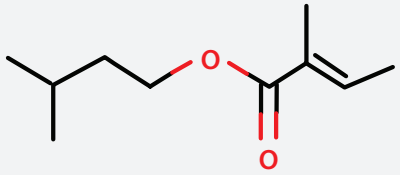
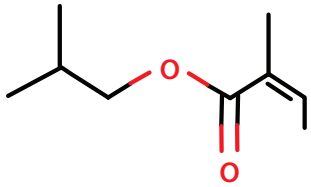
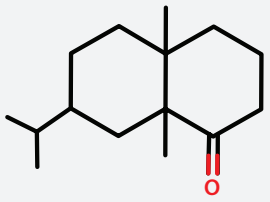
Guaiadene		Sesquiterpene Alkene	Surface cleansing properties	Geranium 0.5-10%
Gurjunene		Sesquiterpene Alkene	• Surface cleansing properties • May provide antioxidant support*	Spikenard 3-13%
Isovalencenol		Sesquiterpene Alcohol	Fragrant aroma	Vetiver 5-20%
Isoamyl tiglate		Ester	Fragrant aroma	Roman Chamomile 5-40%
Isobutyl angelate		Ester	Fragrant aroma	Roman Chamomile 5-40%
Jatamansone		Sesquiterpene Ketone	Calming and relaxing aroma	Spikenard 3-20%

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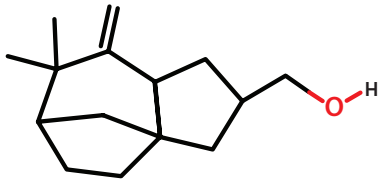
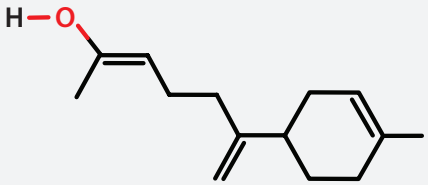
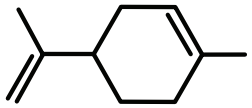
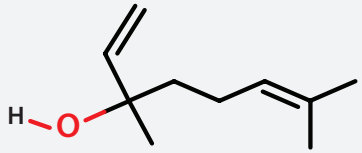
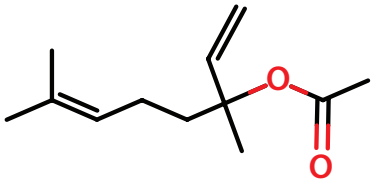
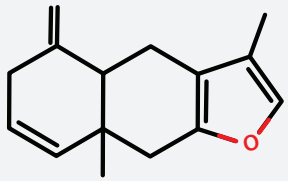
Khusimol		Sesquiterpene Alcohol	May support lung and respiratory health *	Vetiver 5-15%
Lanceol		Sesquiterpene Alcohol	Fragrant aroma	Hawaiian Sandalwood 2-16%
Limonene		Monoterpene Alkene	• Uplifting, energizing aroma • Surface, teeth, and skin cleansing properties • May help reduce appearance of skin blemishes • Posesses internal cleansing properties* • Supports healthy metabolism* • Supports immune, respiratory, gastrointestinal, and nervous system function *	• Tangerine 80-99% • Grapefruit 90-97% • Wild Orange 80-97% • Lemon 55-75% • Lime 40-70% • Dill 30-55% • Bergamot 20-55% • Spearmint 5-30% • Black Pepper 9-25% • Frankincense 5-20%
Linalool		Monoterpene Alcohol	• Calming and relaxing aroma surface cleansing properties • May support healthy immune system function and gastrointestinal health* • Soothes and calms nervous system*	• Coriander 60-75% • Basil 40-80% • Lavender 20-47% • Petitgrain 15-30% • Clary Sage 8-40% • Cilantro 10-35% • Bergamot 3-20%
Linalyl acetate		Monoterpene Ester	• Calming aroma • Surface cleansing properties • May support relaxation of smooth muscles* • Supports heart and cardiovascular health • Promotes gastrointestinal health and immune function* • Soothing and calming effects on the nervous system*	• Clary Sage 40-75% • Petitgrain 40-65% • Lavender 25-45% • Bergamot 10-45%
Lindestrene		Sesquiterpene Ether	Internally cleansing*	Myrrh 1-20%

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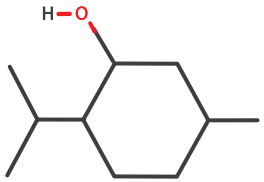
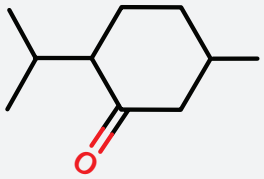
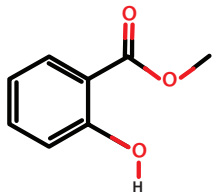
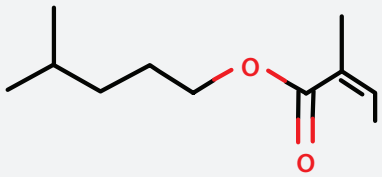
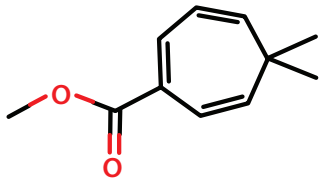
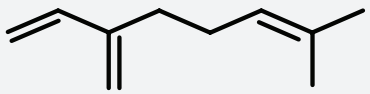
Menthol		Monoterpene Alcohol	• Aromatically uplifting and energizing • Supports feelings of clear breathing • Surface and skin cleansing properties • Cooling and soothing effect on the skin • Helps maintain a clean and fresh-smelling mouth • Insect repellant • May support healthy cellular function and digestive health *	Peppermint 20-60%
Menthone		Monoterpene ketone	• Energizing and uplifting aroma • Surface and skin cleansing • Has a cooling effect on skin • Can help soothe the tissues • May provide antioxidant support *	Peppermint 10-30%
Methyl salicylate		Ester	• Soothing to the skin • May help reduce appearance of blemishes • May help protect against environmental threats*	• Birch >98% • Wintergreen >98%
4-Methylamyl angelate		Ester	Fragrant aroma	Roman Chamomile 5-40%
Methyl thujate		Monoterpene Ester	Woody aroma	Arborvitae 50-70%
Myrcene		Monoterpene Alkene	• Supports skin health* • May support immune system function*	• Juniper Berry 0.0-25% • Tangerine 0.5-8% • Wild Orange 0.5-5%

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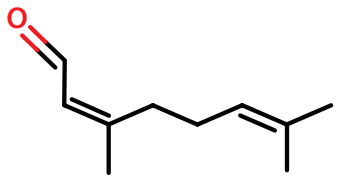
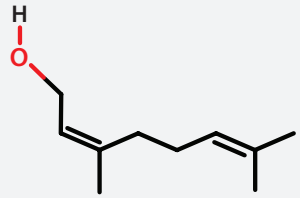
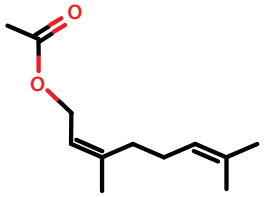
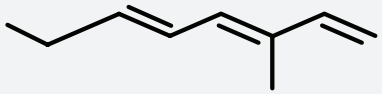
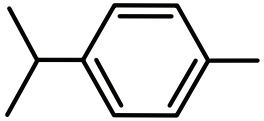
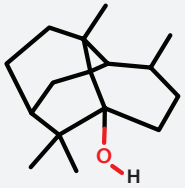
Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
Neral		Monoterpene Aldehyde	• Surface cleansing properties • May support cellular health* • May promote healthy cholesterol levels already in the normal range* • Calming and relaxing aroma; Supports cognitive function* • Supports immune system function *	• Lemongrass 25-50% • Melissa 1-32%
Nerol		Monoterpene Alcohol	Fragrant aroma used in perfumery	Rose 5-15%
Neryl acetate		Monoterpene Ester	Surface cleansing properties	Helichrysum 25-50%
Ocimene		Monoterpene Alkene	Surface cleansing properties	Lavender 0.3-10%
p-Cymene		Monoterpene Alkene	May promote healthy cellular function *	• Thyme 3-35% • Cumin 3-20%
Patchoulol		Sesquiterpene Alcohol	• Cleansing and supportive of immune and respiratory systems* • Promotes gastrointestinal health *	Patchouli 20-40%

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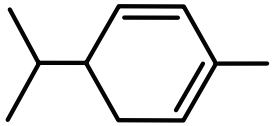
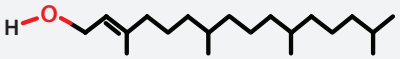
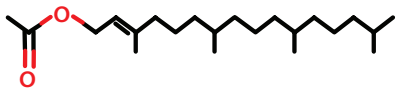
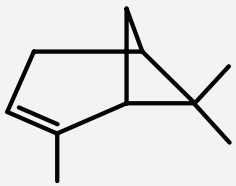
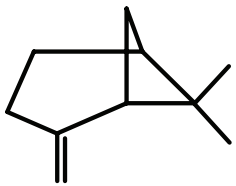
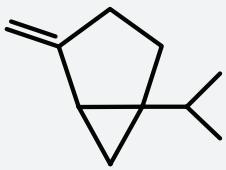
alpha-Phellandrene		Monoterpene Alkene	Supports healthy immune response.*	Pink Pepper Blue Tansy
Phytol		Alcohol	Surface and skin cleansing properties	Jasmine 3-50%
Phytol acetate		Ester	Fragrant compound used in perfumery	Jasmine 5-25%
alpha-Pinene		Monterpene Alkene	• Supports cardiovascular, nervous, and digestive systems* • Supports cellular function* • Helps gums, teeth, and skin look clean and healthy • Soothing to the tissues • Aroma has powerful relaxing effects	• Frankincense 25-65% • Cypress 20-65% • Juniper Berry 24-55% • Coriander 5-20% • Helichrysum 5-20% • Rosemary 5-20% • Siberian Fir 5-20% • Black Pepper 1-20% • Fennel 1-15%
beta-Pinene		Monoterpene Alkene	• Supports immune function and response* • May help maintain healthy blood glucose levels already in the normal range* • Supports healthy respiratory system*	• Douglas Fir 20-40% • Cumin 4-35% • Lime 10-25% • Lemon 6-18% • Black Pepper 2-20% • Bergamot 3-12% • Blue Tansy 2-10%
Sabinene		Monoterpene Alkene	Skin cleansing properties	• Blue Tansy 10-30% • Douglas Fir 5-25% • Marjoram 0.4-33% • Juniper Berry 0.0-30% • Black Pepper 0.1-23%

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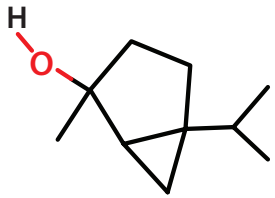
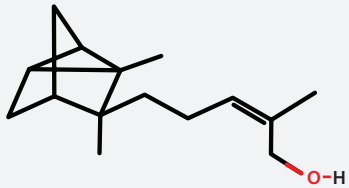
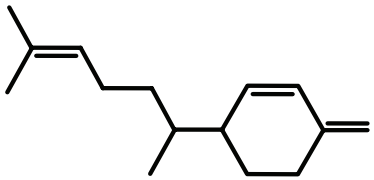
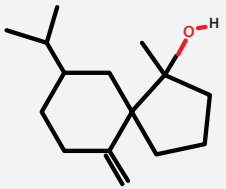
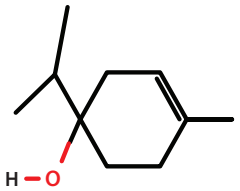
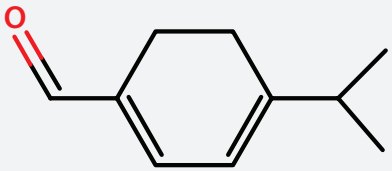
Sabinene Hydrate		Monoterpene Alcohol	May posess antioxidant properties*	Marjoram 0.4-33%
Santalol (alpha and beta)		Sesquiterpene Alcohol	• Uplifting aroma • Soothes and promotes healthy-looking skin when used topically • Promotes cellular health* • Supports the digestive and immune systems *	• Hawaiian Sandalwood 10-60% • Indian Sandalwood 10-60%
Sesquiphell-andrene		Sesquiterpene Alkene	• May provide antioxidant support* • Promotes healthy cellular function* • Supports the immune and respiratory systems*	Ginger 5-20%
Spriojatamol		Sesquiterpene Alcohol	Earthy aroma	Spikenard 0.1-15%
Terpinen-4-ol		Monoterpene Alcohol	• Surface and teeth cleansing properties • Soothing and cleansing to skin • Reduces appearance of skin blemishes • Protects against environmental threats* • Soothes muscles and joints* • May support healthy cellular and immune system function *	• Melaleuca 20-60% • Marjoram 0.1-55%
Terpinen-7-al		Monoterpene aldehyde	Surface cleansing	Cumin 1-35%

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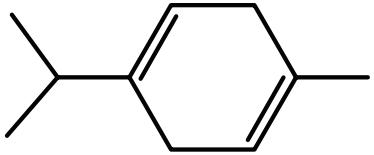
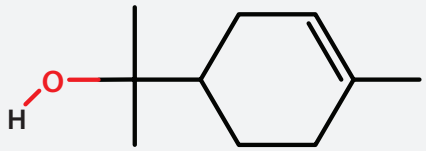
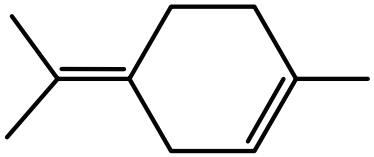
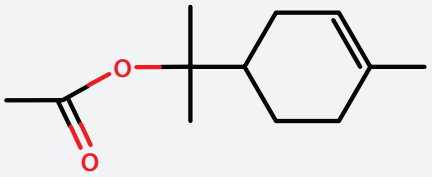
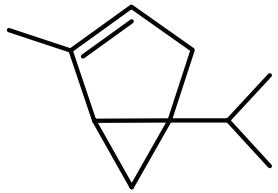
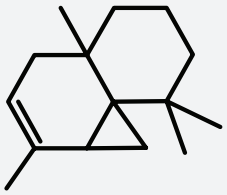
gamma-Terpinene		Monoterpene Alkene	• Surface cleansing properties • Protects against environmental threats*	• Melaleuca 10-55% • Cumin 3-35% • Lime 5-20% • Marjoram 0.5-20% • Lemon 3-16% • Bergamot 3-12% • Coriander 0.1-10%
Terpineol		Monoterpene Alcohol	Calming and relaxing aroma	• Eucalyptus 1-15% • Petitgrain 1-12%
Terpinolene		Monoterpene Alkene	• Promotes feelings of calmness and relaxation when used aromatically • May promote cellular health and immune system function*	Douglas Fir 5-25%
Terpinyl acetate		Monoterpene Ester	• Surface and skin cleansing properties • May support cellular and digestive health* • Supports a healthy metabolism *	Cardamom 25-50%
alpha-Thujene		Monoterpene Alkene	Herbaceous aroma	Frankincense 0.1-10%
Thujopsene		Sesquiterpene Alkene	Woody Aroma	Cedarwood 7-30%

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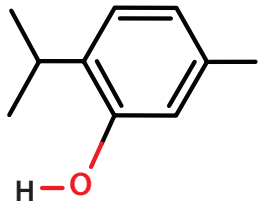
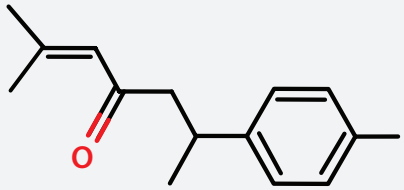
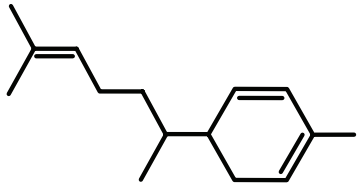
Constituent	Structure	Chemical Classification	Benefits	Percent Composition in dōTERRA oils
Thymol		Monoterpene Phenol	• Invigorating aroma • Surface cleansing properties • Cleansing and soothing to skin • Promotes oral health when used in a mouth rinse • May provide antioxidant benefits* • Supports immune, circulatory, respiratory, cardiovascular, nervous system, and bone health*	• Thyme 30-66% • Oregano 0.5-10%
ar-Tumerone		Sesquiterpene Ketone	Supports healthy nervous system function, healthy cellular function, and immune function.*	Turmeric 15-50%
Zingiberene		Sesquiterpene Alkene	• Promotes cellular health* • Supports the health of stomach and digestive tract*	Ginger 20-40%

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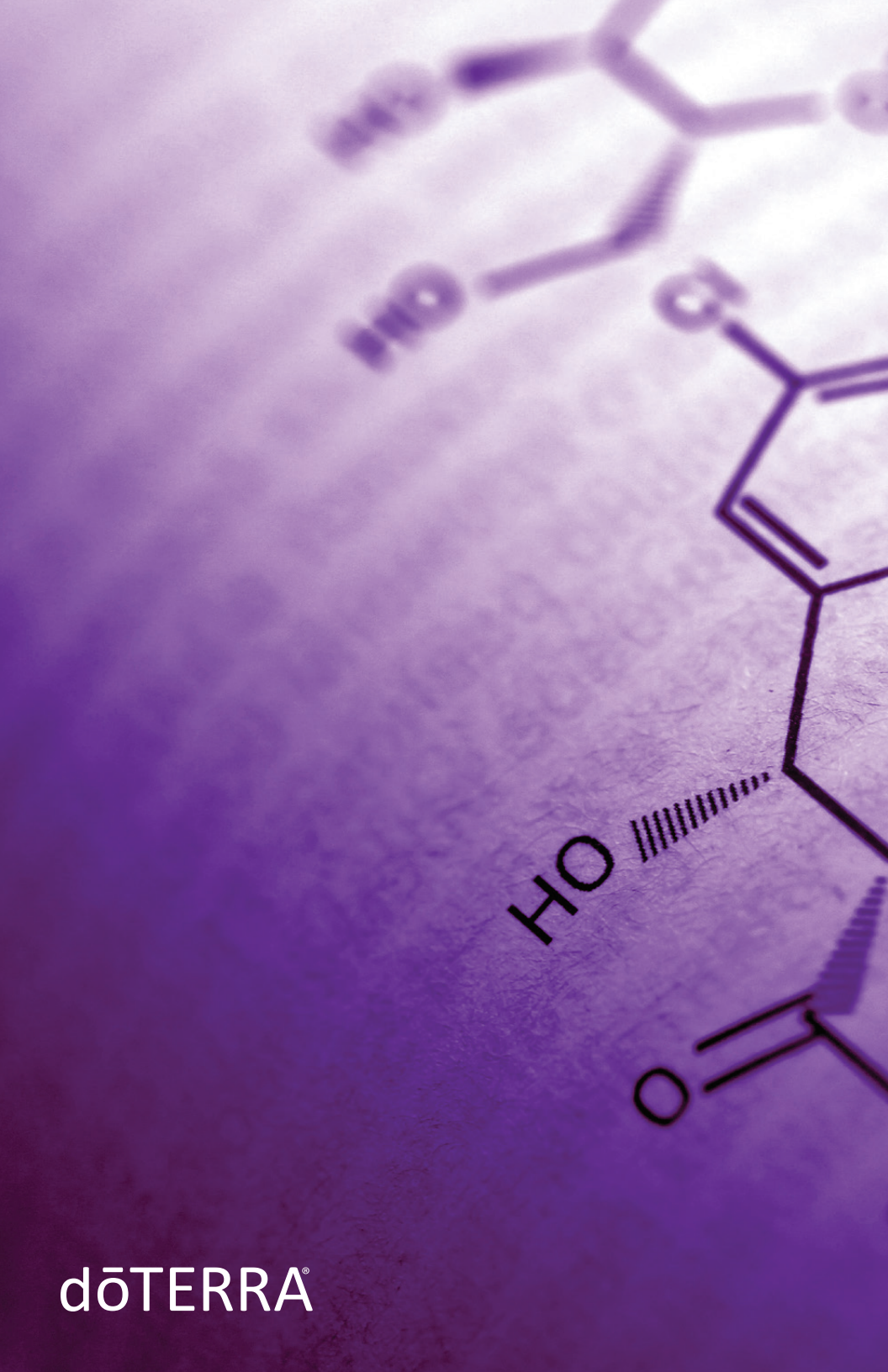

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