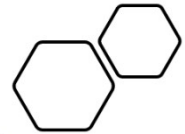


WHITE PAPER



Signature potted bee balm™

MONARDA PUNCTATA L.



www.beyoungth.com

HEARTLAND
RESEARCH GROUP

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Medicinal Benefits of Spotted bee balm (*Monarda punctata* L.) A Powerful Medicinal Plant for An Ancient Hopewell Culture

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- Kevin P. Price, Consultant, Plant Community/Ecosystem Ecologist/

THE HOPEWELL CULTURE

The ancient cultures of the world used medicines derived mostly from plants to treat diseases and other ailments. One such civilization was the Hopewell, also known as the Mound Builders, who inhabited most of the eastern United State (Figure 1). The work by Squire and Davis

preserved a small, but important portion of the Hopewell monuments in their pages and notes as recorded in “Ancient Monuments of the Mississippi Valley”(1847), and the “Aboriginal Monuments of Western New York” (1849).

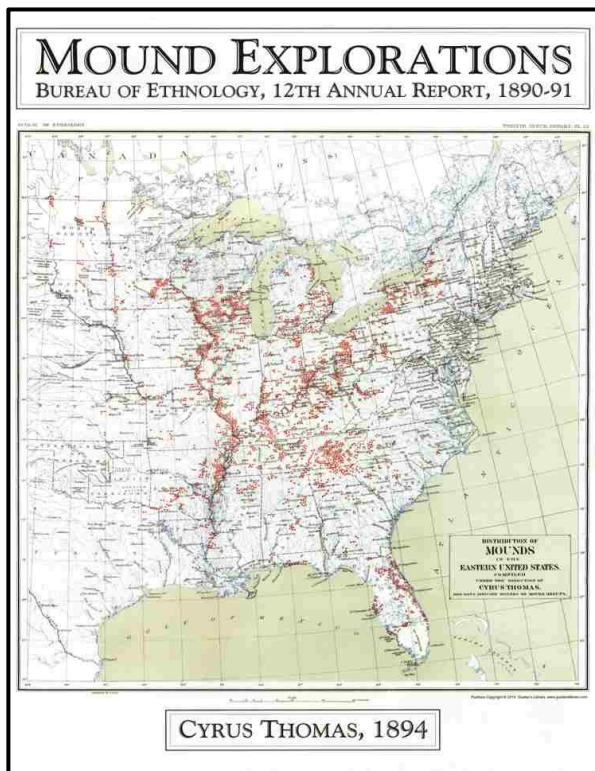


Figure 1. An 1894 Smithsonian Institute map showing many of the Hopewell mounds at that time. It is estimated that prior to European settlements, there were over 1.0 million mounds in the region.

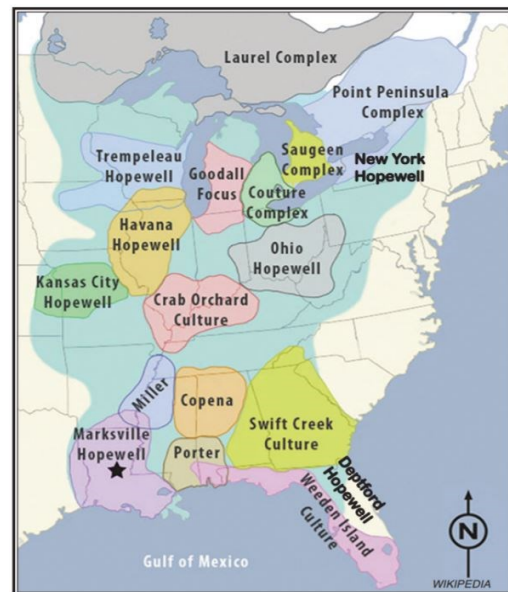


Figure 2. Map of Hopewell Cultures as described by archaeologist.

The oldest Hopewell sites are dated to about 500 BC and found in Northern Florida from where they eventually spread north and westward into the Mississippi Valley areas and followed the

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river corridors into the Ohio Valley. Their sites in the Iowa/Illinois area are dated between 500 BC and 150 BC but vary depending on the location. They migrated into the Great Lakes region

at about 100 AD, and not long after, they suddenly disappear from the area. A general outline of dates associated with these people provided in Table 1.

It is estimated that there were hundreds of thousands of mounds throughout the region before European settlements within the eastern US. There are magnificent mounds in the Ohio region (Figure 3) that show an industrious and religious people. But in this area, archaeologists also find many fortified compounds indicative of a people who were under attack (Figure 4), which probably explains why they kept migrating and why they mysteriously vanished around 400 AD.

Table 1. Hopewell (Woodland) timeline.

HOPEWELL WOODLAND PERIOD		
EARLY WOODLAND	500 B.C.- A.D.1	IOWA FLORIDA TENNESSEE
MIDDLE WOODLAND	A.D.1- A.D. 500	KANSAS EAST TO NEW YORK ALL HOPEWELL
LATE WOODLAND	A.D. 500 - A.D.1000	HOPEWELL ASSIMILATED BY NATIVE TRIBES



With millions of ancient Hopewell people living in the eastern US, there was also a great need for medical treatments. Given the wound-inflicting nature of war, many warriors would need medical treatment to protect against infections and treat other injuries.



Figure 3 (right), (left). Hopewell Mounds along the eastern shoreline of the Mississippi River in Iowa dating at 400 BC to 200 AD.

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A common parasitic infection in the US was malaria that caused severe fever and many deaths at some seasons of the year. When one thinks about malaria, they may not realize that this parasite was a significant cause of sickness and death in the US. Malaria was Endemic in the eastern regions of the US until the late 1940s. It is estimated that over 1 million Civil War soldiers were infected with malaria.



Figure 4. (right) Computer generated model of Fort Ancient in Ohio dating to the late Hopewell period. <https://shakerwssq.org/fort-ancient-hopewell-native-american-earth-works/> (left) Artist's conception of a Hopewell fortified compound. Notice that it is mostly of wood.

Its high prevalence in the Southeastern US is one of the main reasons the Center for Disease Control is headquartered in Atlanta, Georgia (Figure 5).

Given the Hopewell culture's considerable population size and the diseases and ailments ancient cultures encountered; plants of medicinal value would be in great demand.



Figure 5. 1970 US Census data showing the deaths due to malaria. Red area had the highest casualties. Map acquired from US Library of Congress at: [http://memory.loc.gov/cgi-bin/map_item.pl?data=/qmd370m/q3701m/q3701qm/qct00008/ca000095.sjd&style=setmap&itemLink=r?ammem/qmd:@field\(NUMBER+@band\(q3701qm+qct00008\)\)&title=Statistical+atlas+of+the+United+States+based+on+the+results+of+the+nint](http://memory.loc.gov/cgi-bin/map_item.pl?data=/qmd370m/q3701m/q3701qm/qct00008/ca000095.sjd&style=setmap&itemLink=r?ammem/qmd:@field(NUMBER+@band(q3701qm+qct00008))&title=Statistical+atlas+of+the+United+States+based+on+the+results+of+the+nint)

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Recently, researched with the Heartland Research Group encountered the plant *Monarda punctata* (Spotted bee balm, horsemint) (Figure 6) growing in abundance on an ancient Hopewell berm in southeast Iowa.

This plant is a native herbaceous perennial to the eastern U.S. and typically occurs in full sun areas with dry soil in prairies, sandy areas, rocky woodlands, and coastal plains. It is a mint family member that rise typically to 1'-2' tall, sometimes 3'-4'. It is a drought-tolerant member of the Lamiaceae (mint-square stems) family.



Figure 6. (Left) Spotted bee balm (cream-colored tops) growing abundantly across the sandy dry ancient Hopewell berm. (Right) A natural color picture of the ancient Hopewell berm going across the field with the Mississippi River in the background. (Drone acquired image courtesy of Don Cummins, President, Air Data Solutions (<https://airdatasolutions.com/>)).

The web is filled with information indicating that this plant was used for multiple medicinal purposes by the Native Americans. There is mounting evidence that it is also used before them by the people of the Hopewell Culture. The plant is widespread throughout many parts of the eastern US and Canada. Multiple studies show the plant as a prevalent species growing abundantly along the Mississippi Valley River corridors. In Figure 7, it can also be seen that the Hopewell people once also resided.

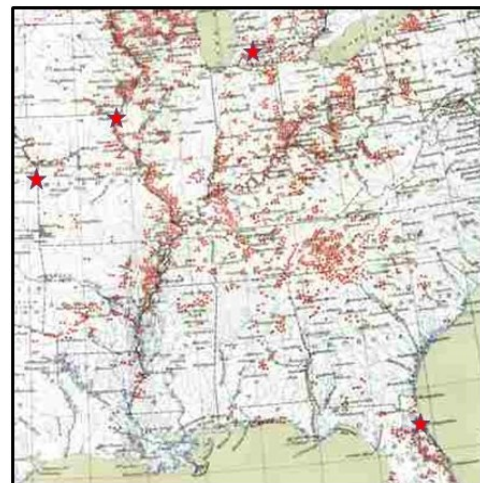


Figure 7 shows a zoom-in of Figure 1 with four locations marked with red stars where we have found Spotted bee balm densely occupying an area where dense populations of Hopewell people once also

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Visual areal correspondence analysis also shows interesting map correspondence between counties in Iowa where Spotted bee balm has been identified and counties where Hopewell sites have been verified (Figure 8). Just because the plant or Hopewell sites are not marked on the map, it does not mean they are not found in a county. However, the general pattern shows the plant is most often found near the east border of Iowa, which is where most of the Hopewell sites have been found. Clearly, both favored the Mississippi River environments.

Given this plant's medicinal values, it is also very possible that it was cultivated in areas where the Hopewell people settled.

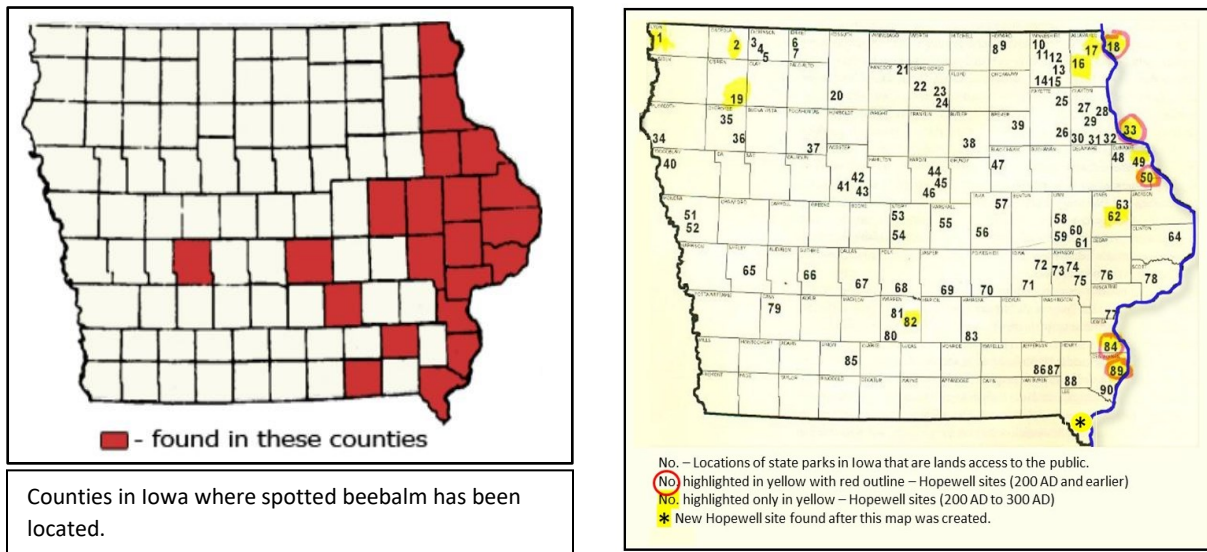


Figure 8. Two base maps of counties in the State of Iowa. (Left) shows counties color in red where botanists have located the Spotted bee balm. (Right) Map showing the locations in Iowa where Hopewell sites have been identified by Iowa archaeologists.

NATIVE AMERICA MEDICINAL USES OF SPOTTED BEE BALM

Native Americans have multiple medicinal uses for Spotted bee balm. It is considered an essential plant among numerous tribes. “Horsemint [Spotted bee balm] was traditionally taken by several native North American Indian tribes to treat nausea and vomiting and encourage perspiration during colds. It was also applied externally as a poultice to treat swellings and rheumatic pains. Nowadays, it is used primarily to treat digestive and upper respiratory tract problems. The leaves are carminative, diaphoretic, diuretic, emmenagogue, rubefacient, stimulant, stomachic, and vesicant. An infusion of the leaves is used in the treatment of flatulence, nausea, indigestion, catarrh in the upper respiratory tract, and to induce sweating and promote urination.

The herb is principally used externally as a rubefacient, applied as a poultice. It helps lessen arthritic joints' pain by increasing the flow of blood in the area and thereby hastening the

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flushing out of toxins. The leaves can be harvested before the plant flowers or harvested with the flowering stems. They can be used fresh or dried.”

[https://practicalplants.org/wiki/Monarda_punctata#:~:text=Medicinal%20uses\(Warning!\),treat%20swellings%20and%20rheumatic%20pains](https://practicalplants.org/wiki/Monarda_punctata#:~:text=Medicinal%20uses(Warning!),treat%20swellings%20and%20rheumatic%20pains)

“Horsemint [Spotted bee balm] tea [is taken] for flatulent colic, suppressed urine, diarrhea, rheumatism, and digestive and other stomach problems such as nausea and vomiting. Native Americans used the plant for fever, flu, catarrhs, chills, decreased menstrual flow, and inflammations. One tribe drank a cold extract to relieve backache, and another to stimulate heart actions. The oil derived from the leaves promote sweating when rubbed on the body. An oil high in thymol expels worms.

Horsemint is efficient in controlling vomiting due to exhaustion, persistent nausea with flatulence, or vomiting of alcoholics in whom it will impact a temporary tone to the stomach.”

<http://medicinalherbinfo.org/000Herbs2016/1herbs/horsemint/>

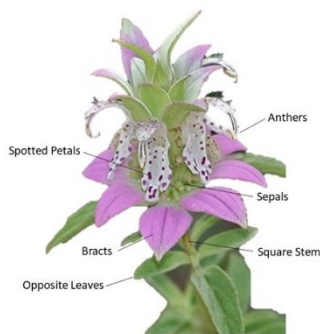
“Native Americans made a tea of it or used it as a snuff to remedy cough, constipation, cramps, enteritis, fever, headache, and stomachache. The Fox [Tribe or Meskwaki Tribe] placed leaves of horsemint (Spotted bee balm) near the nostrils of persons near death to rally them. The Ojibwa merely rubbed it into the skin.” <https://www.motherearthliving.com/mother-earth-living/herbal-stamps>

For additional reading, refer to references 16 – 20 in the reference section.

SPOTTED BEE BALM BOTANY



Spotted Beebalm



Spotted beebalm (*Monarda punctata*) is an herbaceous plant in the mint family, Lamiaceae. Common names include dotted beebalm, horsemint, and spotted horsemint.

It is an upright perennial with multiple stems and a few short rhizomes. Stems are square and pubescent with brownish or purplish color. The aromatic leaves are arranged opposite from each other on short petioles along the stems. Leaf blades are medium green and narrowly lanceolate.

There are 9 subspecies of the plant that favor dry sanding soils and it is native to eastern Canada, the eastern United States and northeastern Mexico.

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WHY IOWA SPOTTED BEE BALM

The Iowa Spotted bee balm grows in an environment where it has developed an essential oil profile incredibly beneficial to human health. This variety requires little watering, making it drought resistant and has developed resistance to insects and most diseases. It is a perennial, making it available each year from the previous year's growth. The oregano-scented foliage is repugnant to mammalian herbivores and rarely consumed by them (Figure 9).

As discussed in the previous section, Spotted bee balm has been traditionally used by native North American Indian tribes with some in Iowa and the Great Lakes regions. Gas Chromatograph/Mass Spectrometer analysis shows the plants on the Iowa Hopewell site are significantly different in their carvacrol and thymol concentrations. The leaves can be harvested before the plant flowers or harvested with the flowering stems. They can be used fresh or dried.



Figure 9. Spotted bee balm from the Iowa Hopewell site. This variety has the greenish colored bracts.

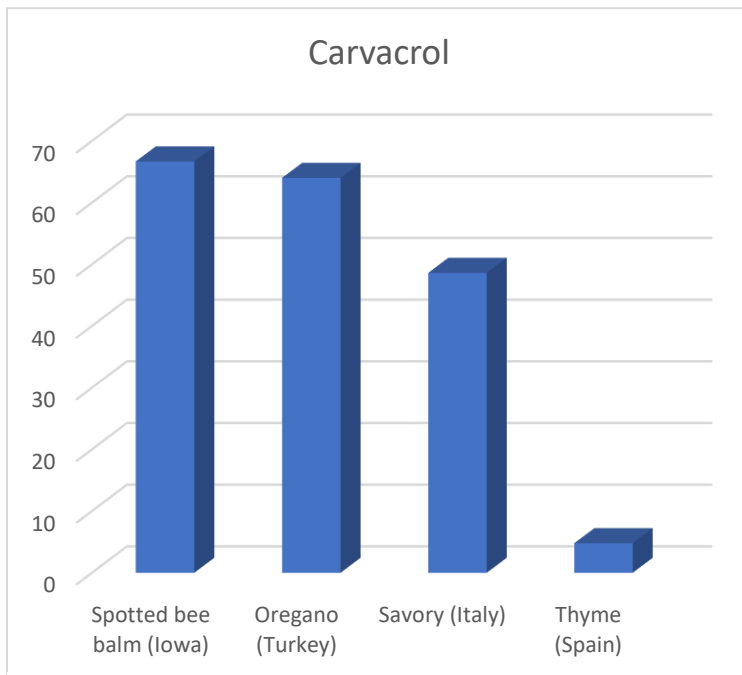


Figure 10. Carvacrol content compared to other well-known essential oils. Sample from Iowa 2020

The plant is a rich source of the medicinal essential oil 'carvacrol', which is antiseptic [18,19,20]. The plant has been commercially cultivated for its essential oil, though this is now produced synthetically.

Of course, these are not the only compounds in horsemint; hence, this medicinal plant's interest as a whole herb and essential oil is not just a lab-isolated extract (Figure 10).

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Environmental Factors on Essential Oils

Many factors must be considered to produce high quality, pure, and potent essential oils. One of the most important factors is the environment and climate where the plant will be grown. There is much more to the process than merely grabbing a seed and planting in the ground. The entire environment plays an unprecedented role in the quality of what will become the essential oil. For example, the same aromatic plant growing in two different countries will yield completely different oils. One of these plants may be therapeutic for emotional uneasiness, and the other may be therapeutic for a burn. The essential oil action's difference has nothing to do with the plant itself, but the environment. Essential oils are made of volatile aromatic compounds.

These aromatic compounds are tiny, with an exceptional tendency to change from a liquid state to a gas state rapidly at room temperature. Whereby giving them the name "aromatic." These incredible aromatic molecules are so microscopic that a single drop of essential oil can contain upwards of 40,000,000,000,000,000,000 (40 million trillion) of them. These unique aromatic molecules are manufactured within the plant to counteract the collective effects of their environment. As small as it may be, a change to the environment is enough to change the essential oil's therapeutic benefit entirely. One example of a slight shift in the composition of essential oil by just a few more hours of sunlight is that of peppermint.

Peppermint needs a specific number of daylight hours to switch from a low producing aromatic plant to a high yielding aromatic plant. Peppermint's exposure to a particular amount of daylight allows it to change in the essential oil composition from menthone to menthyl acetate. To confirm just how much the number of daylight hours affects this process, researchers propagated peppermint in Munich, Germany, and Izmir, Turkey (Figure 11). After the experiment concluded, all the peppermint planted in Munich, Germany, contained considerably higher menthol levels than those grown in Izmir, Turkey. This phenomenon was explained by the amount of sunlight the peppermint plant received at the location it was planted. Munich, Germany, had two additional hours of daylight during the day than Izmir, Turkey, and that slight change was enough to change the essential oil produced. Several other factors affect the quality of an aromatic plant and its essential oil byproduct.

- Location (country of origin.)
- Elevation
- Growing and cultivation practices.

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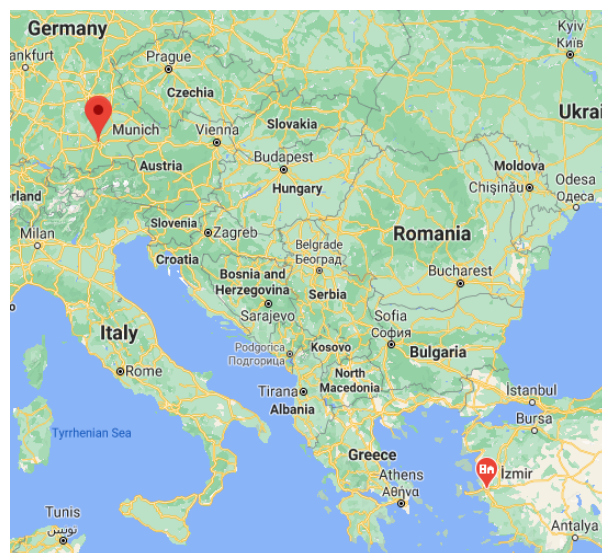


Figure 11. Munich Germany Coordinates: 48°08'N 11°34'E Izmir Turkey Coordinates: 38.42°N 27.14°E

- Propagation (seed selection or cloned seeds)
- Soil
- Climate
- Moisture (e.g., too much or not enough)
- Humidity
- Sunlight
- Insects, pest, and microorganisms

As the Hopewell culture migrates due to internal warfare, following the waterways as their roads, it is evident that they cultivated the *Monarda punctata* as their medicinal plant. This plant chemical defense system would change to survive in the changing environment. This powerful natural evolution is nature's way to deal with the different challenges in the area, giving them the protection needed for their health (Figure 7).

Purity of Essential Oils

The purity of essential oil is its most important characteristic, but Experts estimate that 80% of commercially labeled "pure" essential oils are adulterated somehow. Researchers have found that when an essential oil is diluted, its effectiveness is dramatically reduced. Additionally, an essential oil that is not pure exposed the user to the risk of putting in their body heavy metals, adulterants such as fragrances, carriers, synthetic compounds, and invalid plant material then what is advertised on the label. These adulterants increase the risk of improper use of the essential oil leading to sickness or injury and can cause mild to severe irritation and allergic reactions. Since there is no accepted standard for essential oil purity, Be Young has partnered with a 3rd party laboratory that is the foremost authoritative verifying of essential oils purity. With this partnership, each essential oil offered through Be Young will be tested, given a stamp of approval of its authenticity and purity. Additionally, as the foremost research laboratory on essential oils, each essential oil will be subject to an exhaustive verification against a database of thousands of potential contaminants essential oils can be adulterated. Ensuring only the purest essential oils are ever offered through Be Young through a standard provided through our third-party laboratory partner, we called the Be Young Guaranteed Certified Pure Standard. This standard is not a globally recognized standard or an industry-standard since no such standard exists. Instead, it is an internal standard in which you can rest assured that every essential oil is tested through the most thorough and exhaustive testing process to ensure that when we say 100% pure, you know it means 100%.

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EOBBD High Quality Guarantee

The terms "High Quality" and "Pure" have a very different meaning for essential oils. High quality typically is referred to as the essential oil's ability to perform and provide a benefit. Pure is about the actual product within the bottle. A perfect example of this is when two pure essential oils are used, and one of the products performs better than the other for the desired benefit. Does this mean the product that showed fewer benefits is not pure? It could! It could also say that the compounds responsible for that beneficial action in the essential oil were not present within the essential oil or not at the proper ratios to get the desired response. These therapeutic compounds found in essential oils act as the plant's immune system. It is protecting from disease, pests, and the environment. Because the plant is always adjusting to its environment and stimulus, numerous factors impact the chemical compounds the essential oils will produce when harvested and distilled. For instance, changes in the temperature, daylight hours, humidity, moisture, soil type, pest, water quality, fertilizer, chemicals, noises, and even environmental changes can impact the compounds that create the essential therapeutic benefits oil. For over three decades, Dana Young, the owner and founder of Be Young Total Health, has traveled the world and studied with some of the foremost experts on essential oils, including Dr. Daniel Penoel and Pierre Franchomme. Dana was also privileged to participate in a research database established in France that focused on identifying the plants' chemical compounds responsible for the plants' therapeutic actions. With this extensive knowledge and experience, Dana Young develop the Be Young EOBBD High-Quality Database (Figure 12). This database provides proprietary information identifying a standard for the essential oils offered through Be Young concerning therapeutic compounds and their ratios to ensure the high-quality therapeutic action so many have come to love from Be Young's essential oils [22, 23,24].



Figure 12. EOBBD Seal stands for Essential Oil Botanically and Biochemically Defined.

Quality Policy

Culture. Our culture is built on the principles of:

- Quality without compromise
- Responsibility to operate in an environment of integrity and transparency
- Trust & Love for our fellow men and women
- Knowledge & Empowerment to drive positive life changes

Rights. We believe you are entitled to:

- Pure and high-quality life-restoring products
- Professional relationship with Be Young that puts you first
- An Experience that is positive, warm, and inviting

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The same principles that governed our company in the beginning still guide us today. Because of our commitment to pure, all-natural, clean, and life-restoring products, Be Young has remained a debt-free company to prevent outside influencers from gaining control and compromising the product line. The above means you will never find any synthetic ingredients, harsh fillers, or artificial colors and flavorings. Be Young only provides a product used first in our family, then we offer it to you.

- Third-party testing on every batch of essential oil
- Testing available to view on every essential oil
- Internal strict guidelines that govern our purity commitment
- Guaranteed 100% pure essential oil of the plant species identified on the label or your money back.
- Free informational and educational literature to assist you with using your Be Young essential oils with confidence
- Powerful and life-changing techniques and modalities using your essential oils for physical, mental, and emotional support
- Heavy metal testing on every batch of essential oils
- 30+ years of professional experience in all aspects of essential oils (seed selection, cultivation, harvesting, distillation, manufacturing, testing, application, and education)

Gas Chromatograph and Mass Spectrometry (GC/MS)

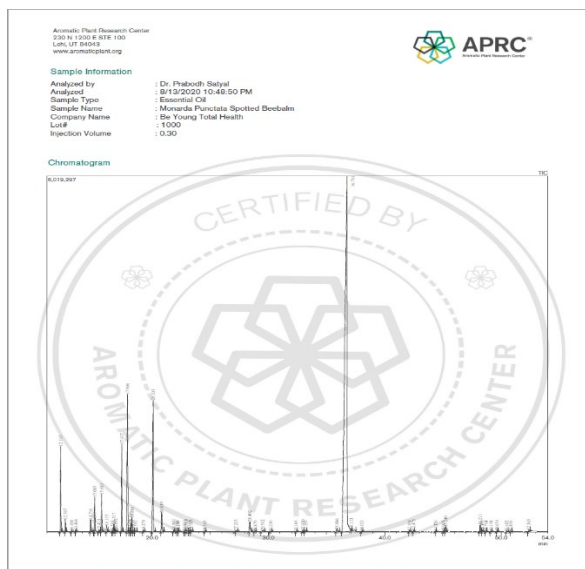


Figure 13. Gas Chromatograph and Mass Spectrometry (GC/MS) of Spotted bee balm sample from Iowa 2020

With a Gas Chromatography, the essential oil is vaporized and passed through a long column to separate the oil into its components (Figure 13). Each component will travel through the column at a different speed, depending on its molecular weight and chemical properties, and is measured as it exits the column. Using this testing method, quality control analysts can determine which compounds are present in a test sample. Mass Spectrometry is used together with Gas Chromatography to determine the composition of essential oil further. In Mass Spectrometry, the constituents previously separated by GC are ionized and sent through a series of magnetic fields. Using the molecular weight and electrical charge, each component's amount can be identified, providing additional insights into the essential oil potency.

Heavy Metal Test

Oils that have been appropriately distilled should have no heavy metals. To be sure, Be Young essential oils are subjected to an additional test that assesses the absence of heavy metals.

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Organoleptic Testing

Organoleptic testing, while not a strict quantifiable test, this approach uses the qualitative human senses of sight, smell, taste, and touch as used in many industries. For the average person, it may be hard to distinguish slight changes from oil to oil. Still, for an expert distiller, it provides immediate clues to the acceptability of essential oil.

HARVESTING THE PLANT MATERIALS

The Spotted was bee balm found growing abundantly on an ancient Hopewell site in Iowa. In the late afternoon of August 6, 2020, 13 pounds of these fresh plant materials were harvested by cutting the plant stems with leaves and flower parts intact at about 8 inches above the ground (Figure 14).

The fresh-cut material was immediately placed into an insulated shipping container and ice packed to keep the plant material cool. The next morning the plant materials were flown to Salt Lake City, Utah, and taken directly to Be Young Total Health Corporate Office, where essential oil extraction was undertaken upon arrival that afternoon.



Figure 14. Harvesting the Spotted bee balm on an ancient Hopewell site in Iowa. Plant material was packed into an insulated shipping container and placed on ice.

ESSENTIAL OILS FROM STEAM DISTILLATION

The primary goal of plants, like all organisms, is to grow and reproduce. Therefore, most of the metabolites produced by plants are polysaccharides and proteins that give the plants structure and function. Plants also have small amounts of secondary metabolites: compounds that are not directly related to growth or reproduction but are more of the plant's defense system. Many of these secondary metabolites have complex chemistry, and some have commercial value. They can be excreted through plant glandular trichomes (Figure 15)

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Most of the plant compounds used in perfumes, flavoring, and natural medicines are secondary metabolites. The steam causes the essential oil to be released from microscopic protective sacs. As the vapor mixture flows through a condenser and cools, it yields a layer of oil and a layer of water. The essential oil rises to the top and is separated from the hydrosol (floral water) and collected.

Extraction Methods

Since plants only make small amounts of secondary metabolites, a considerable amount of plant material is needed to produce a quantity of essential oil. Over millennia, people have developed several methods to extract and concentrate desired compounds from plants. One well-known example is hot-water extraction used to make coffee, teas, and soup stocks.

Solvents such as alcohol can also be used to make liquid extracts for food flavorings and perfumes. Cold pressing to extract oils, fats, and waxes can be used for compounds sensitive to heat, such as jasmine. The best extraction method to use depends on essential oil plant volatility (ease of evaporating) and polarity (water-loving or water-hating) of the desired compounds.

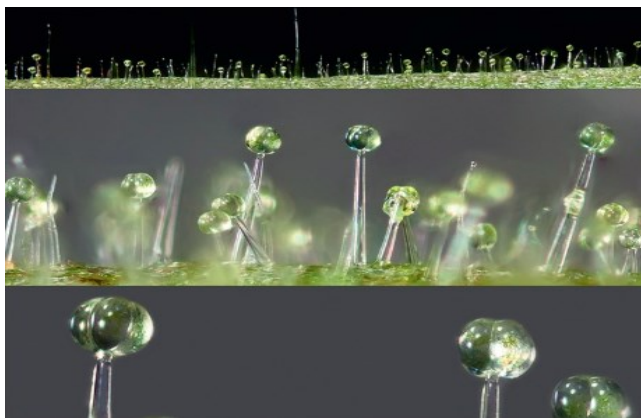


Figure 15. Glandular trichomes are specialized hairs that secrete or store large quantities of a plant's secondary metabolites.

Steam is used to rupture the oil membranes in the plant and release the essential oil. The steam carries the essential oil to a condenser and then as it re-liquefies the lighter essential oil floats on top. The best cooking chambers are made of non-reactive metal. Which minimizes the essential oil from being adulterated (changed) by reactive metals such as copper and aluminum. The best metal that is non-reactive is stainless steel! Also, vertical steam distillation seems to produce the best quality oil when distilling essential oils. There is no risk of overheating the plant material! Dry steam distillation of the plant biomass was done in a vertical stainless-steel steam chamber with a stainless-steel condenser attached to a glass separator. The heat was created by a gas hot plate, producing boiling water rising through the biomass chamber, rupturing the essential oil glands, releasing the essential oil as a vaporous

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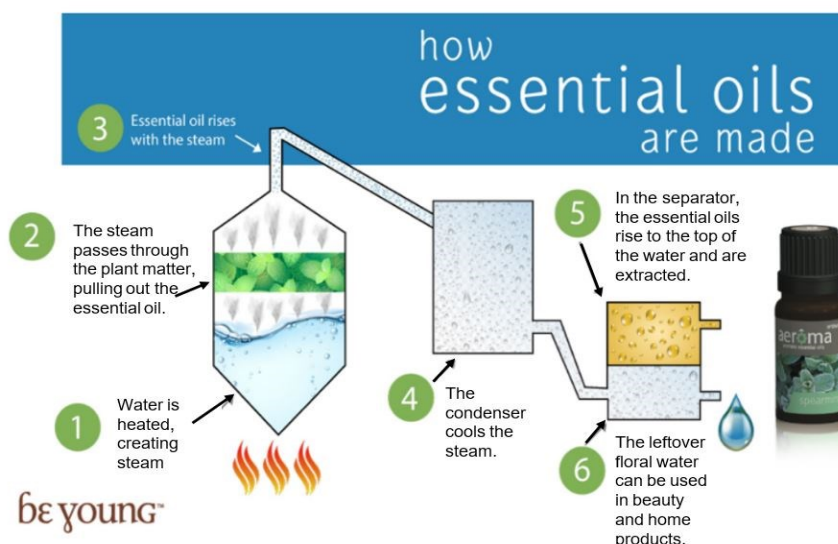


Figure 16. Schematics of dry steam distillation system used to extract the Spotted bee balm essential oil.

gas into the condenser. Coldwater runs through the separator coil condensing the steam and vaporous gas back into water and essential oil (Figures 16 and 17).

Dry steam distillation is different from “wet” steam distillation because the biomass does not come in direct contact with the water. The vertical design allows any water that condensed on the biomass to drain back into the boiling chamber.

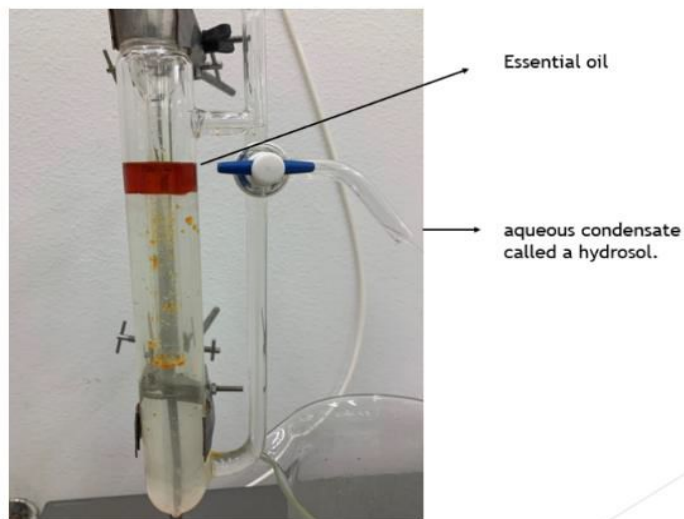


Figure 17. Separator tube where essential oil and hydrosol are separated.

The separator is specially designed to retain both heavier-than-water oils and lighter-than water oils while allowing excess water containing the water-soluble compounds to be drained out and collected separately.

The aim of distillation is to cause the glands containing the essential oils to release their contents. The best extraction method to use depends on essential oil plant volatility (ease of evaporating) and polarity (water-loving or water-hating) of the desired compounds. Steam distillation, used at the Be Young Total Health facility, was

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implemented to extract the essential oil from the Spotted bee balm collected on the ancient Hopewell site in Iowa.

Short Cut the Distillation Process

Distilling essential oils can be time-consuming and costly! Most commercially made essential oils are distilled at 155 pounds of pressure with a temperature of about 350 degrees for about 15 to 20 minutes! This will change the compounds and can make them dangerous. Some botanicals store their precious volatile aromatic compounds within their leaves or flowers while others may store them within their rinds, seeds, or other plant parts. Plant parts that produce essential oil are:

- Berries (anise, juniper)
- Seeds (almond, nutmeg, cumin),
- Bark (cinnamon, sassafras),
- Wood (cedar, rosewood, sandalwood),
- Rhizome (ginger),
- Leaves and stem (basil, bay leaf, sage, eucalyptus, oregano, peppermint, pine, rosemary, spearmint, tea Tree, thyme, wintergreen, lemon grass, spotted be balm),
- Resin (frankincense, myrrh),
- Flowers (chamomile, clove, geranium, jasmine, lavender, marjoram, rose, Spotted bee balm),
- Peels (orange, lemon, lime, grapefruit),
- Roots (valerian).

The extracted Spotted bee balm essential oil was hand-delivered to an essential oil's analysis laboratory for gas chromatography-mass spectrometry (GC-MS) analyses (Figure 18). Utilizing the latest techniques and scientific equipment, they perform several tests to verify consistency in essential oil chemical profiles and detect contamination and adulteration of an oil. This method is used to separating volatile compounds in essential oils into individual components and identifying each of them and their percentage of the total sample.

CHEMICAL COMPOSITION

The chemical analyses of the Spotted bee balm essential oil revealed 56 compounds. There were no adulterations found at this level of testing rendering the sample 100 % pure. Experts estimate that 80% of commercially available "pure" essential oils are adulterated in some way, by using a third-party laboratory that provides clients with a



Figure 18. Gas chromatography–mass spectrometry (GC-MS)

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reliable source for verifying essential oil purity. Their expert staff has decades of combined experience in testing essential oil purity. They have studied and developed various methods to detect adulterations by using new techniques and state-of-the-art equipment. The top 10 compounds make up 93.97 % of the essential oil and are listed below, leaving 46 compounds to make up the remaining 6.03 %. The synergistic relationship of these compounds is greater than the individual parts. Most medications are a reductionist formula, where compounds are isolated, losing the whole's power and creating a list of side effects. Whenever a compound is isolated from nature, it can become toxic to the human body.

The top ten compounds in the Spotted bee balm are:

Carvacrol	1-Octen-3-ol
gamma-Terpinene	Myrcene
para-Cymene	cis-Sabinene hydrate
alpha-Terpinene	beta-Phellandrene
alpha-Thujene	Thymol

Essential oils in the complete form may provide higher control and lower toxicity than their isolated single component making the complete extraction stand out. There exist bioactive with having multiple compounds together that bacteria and viruses have a hard time mutating too. The high level of the natural compound in the whole synergistic help give a broader spectrum of control when it comes to helping the body.

SPOTTED BEE BALM AND ITS CHEMISTRY

Spotted bee balm is very high in terpenes. What Are Terpenes? Terpenes, also known as isoprenoids (Figure 19), are the largest and most diverse group of naturally occurring compounds that are mostly found in plants, but larger classes of terpenes such as sterols and squalene can be found in animals. They are responsible for the fragrance, taste, and pigment of plants. Terpenes are classified based on organization and number of isoprene units it contains. (1). An isoprene unit is a building block of terpenes gaseous hydrocarbon containing the molecular formula C₅H₈. Terpenes and terpenoids are terms that are often used interchangeably, but the two terms have slight differences; terpenes are an arrangement of isoprene units that are naturally occurring, volatile, unsaturated 5-carbon cyclic compounds that give off a scent or a taste to defend itself and act as a thermal protectant, and has various medicinal uses. Throughout the years, the essential oil revolution has brought new scientific research and awareness of the numerous medical benefits of aromatherapy. Terpenes, also known as terpenoids, are the largest and most diverse group of naturally occurring compounds. Terpenes, also known as terpenoids, are the largest and most diverse group of naturally occurring compounds. Based on the number of isoprene units they have, they are classified as mono, di, tri, tetra, and sesquiterpenes. They are mostly found in plants and form the major constituent of essential oils from plants. Among the natural products that provide medical benefits for an organism, terpenes play a significant and variety of roles.

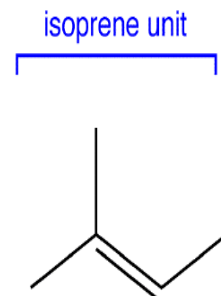


Figure 19. Isoprene basic chemical

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Terpenes and Terpenoids. The common plant sources of terpenes are oregano, thyme, tea tree, Spanish sage, marjoram, citrus, e.g., lemon, orange, mandarin, and now Spotted bee balm. Terpenes have a wide range of medicinal uses, among which anti-plasmodial activity is notable as its mechanism of action is like the popular antimalarial drug in use—chloroquine (Table 2). The interesting mechanism behind the terpene activity is that it binds to the hemin part of infected erythrocytes and kills the parasite just like the famous antimalarial drug chloroquine. Monoterpenes specifically are widely studied for their antiviral property. With growing incidents of cancer and diabetes in the modern world, terpenes also can serve as anticancer and antidiabetic reagents. Along with these properties, terpenes also allow for flexibility in the route of administration and suppression of side effects.

Table 2. shows the different types of terpenes

Classification	Carbon atoms	Species produced from	Medicinal uses
Monoterpenes	C ₁₀	organum vulgare	Fragrances, repellent
Sesquiterpenes	C ₁₅	thymus vulgaris	Treat malaria, treat bacterial infections, and migraines
Diterpenes	C ₂₀	helichrysum italicum	Anti-inflammatory, cardiovascular diseases
Triterpenes	C ₃₀	citrus sinensis	Wound healing, increases circulation

Certain terpenes were widely used in natural folk medicine. One such terpene is carvacrol, which holds anti-inflammatory, antioxidant, anticancer, antiseptic, anti-plasmodial, astringent, digestive, diuretic, and many other properties. Carvacrol has also become a recent trend in healthy foods and open doors for several medical research types. This chapter summarizes the various terpenes, their sources, medicinal properties, mechanism of action, and the recent studies that are underway for designing terpenes as a lead molecule in modern medicine.

In a 2014 peer-reviewed scientific publication titled, "*Antibacterial activity and mechanism of action of Monarda punctata [Spotted bee balm] stated its main components against common bacterial pathogens in respiratory tract*" demonstrated well the importance of using a whole essential oil as opposed to isolated constituents of the whole (1).

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As part of this study, three compounds extracted from Spotted bee balm were tested including *P-cymene*, *Limonene*, and *Thymol* and as a fourth treatment, the whole Spotted bee balm (*Monarda punctata*) This bacterium infects approximately 700 million people worldwide, and of the severe cases, there is a 25% mortality rate. Their test results are shown in the bar chart essential oil was included in the test. These four compounds were tested for effectiveness in killing (oxidizing) a bacterium called – *Streptococcus pyogenes*. (Figure 20) in which *Monarda punctata* as an essential oil was many times more effective in treating *Streptococcus*.

Due to their complex chemical composition, essential oils have no specific cellular molecule that binds to another (usually larger) molecule. As lipophilic mixtures, they can cross the cell membrane and permeabilize, degrade the layers of polysaccharides, phospholipids, and fatty acids, killing bacteria, viruses, or fungi. They also overwhelm the bacteria's defense mechanism and oxidize (burn) the cell resulting in the denaturing of cell wall protein molecules. The chemical constituents of plant essential oils differ among species. Some factors that can affect these constituents include the geographical location, environment, and stage of maturity. The chemical difference

caused by the factors listed above can make essential oils from the same plant species impotent as an antimicrobial agent against various pathogenic microorganisms. For example, the primary chemical constituents of oregano essential oil (carvacrol and thymol) were shown to differ in their origin and antimicrobial property. The Iowa Spotted bee balm is very high in the Phenol family specifically Carvacrol.

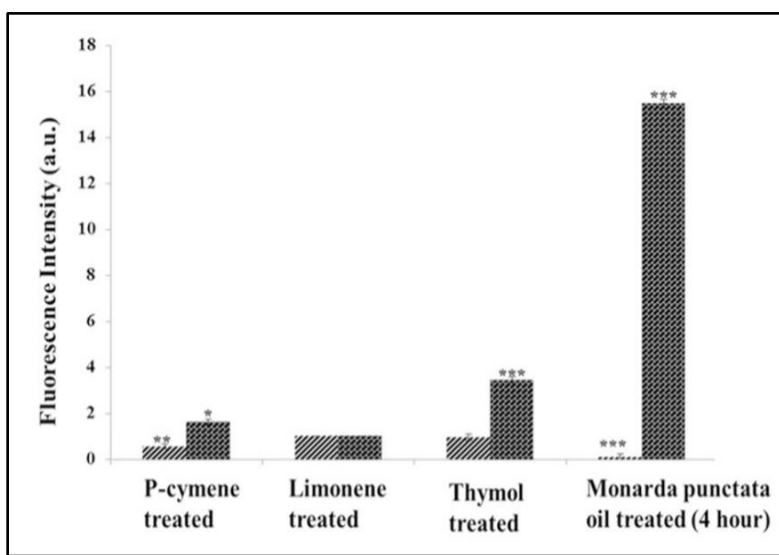


Figure 20. Illustrates how multiple chemical compounds within essential oils have a synergistic effect. *Monarda punctata* essential oil with its multiple synergistic reactions significantly outperformed the 3 isolated compounds in treating *Streptococcus pyogenes*. This conclusion is supported using fluorescence intensity (y-axis) that increases as the Reaction Oxidation Species (ROS) increases because of bacteria being destroyed by oxidation (burning) and denaturing of the organism.

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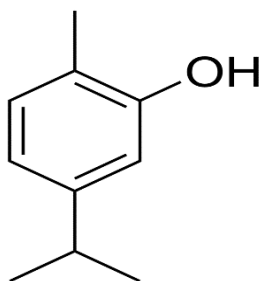


Figure 21. Chemical formula for Carvacrol

Carvacrol. Carvacrol, 2-methyl-5-(1-methylethyl)-phenol, is a small molecule present in many plant species of the Lamiaceae family, including oregano (*Organum vulgare*) and thyme (*Thymus vulgaris*) and (*Monarda punctata*) (Figure 21). Carvacrol is the major component in these plants [1] and is a volatile secondary metabolite that is liquid at room temperature, insoluble in water, but soluble in ethanol.

Carvacrol has one single hydroxyl group (–OH) next to the methyl group in the aromatic ring. The –OH group's unique position in carvacrol plays a critical role in its chemical and biological characteristics [5]. Carvacrol is considered as a safe substance being used for human consumption in the United States and globally. This compound it found abundantly in the Iowa Hopewell site Spotted bee balm (Figure 22).

Antimicrobial Activity of Carvacrol and Associated Mechanisms. Carvacrol has been studied extensively for its antimicrobial activity in the medical field and the food processing industry, where many of the targets are bacteria and fungi [1–3,6,7,18]. The antimicrobial activity of carvacrol, techniques that can be used in assessing its efficacy, its modes of action, interaction with other agents, and formulation development for its useful application have been reviewed in many publications [1–3,6]. In addition to bacterial and fungal microorganisms, carvacrol was also found to be effective against viral particles (M-CoV) [8,9] as well as larvae and adult insects [10–12].

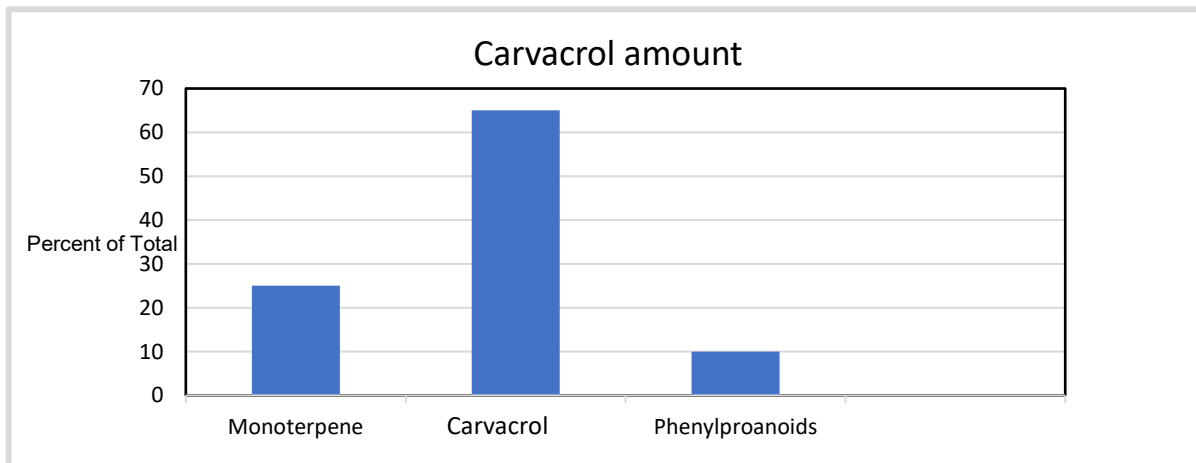


Figure 22. Carvacrol is the main chemical compound in the Iowa Spotted bee balm, comprising over 60% of the essential oil. Carvacrol is chemically classified as a monoterpene phenol since it is derived from two isoprene units and contains a benzene ring with an alcohol group. Carvacrol has been heavily researched due to its many health benefits; a search for “carvacrol” in the National Institute of Health’s PubMed research database returns over 1,400 research studies.

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Anti-bacterial. High levels of Carvacrol may help fight certain types of bacteria. For instance, *Staphylococcus* is a common type of bacteria that causes staph infection. Researchers are also exploring the use of Carvacrol for antibiotic-resistant bacteria. A 2014 study found that high levels of both Carvacrol and thymol were effective tools in treating SIBO (small intestine bacterial overgrowth).

The antibacterial activity of Carvacrol and p-cymene (a precursor of Carvacrol) was studied against the foodborne microorganism *V. cholerae* to evaluate these compounds' potential use preservative agents. Carvacrol showed an excellent inhibitory effect against *V. cholerae*, while p-cymene does not demonstrate this activity. It is interesting to note, however, that p-cymene can enhance the inhibitory effects of Carvacrol when the two compounds are used together (Figures 20 and 23).

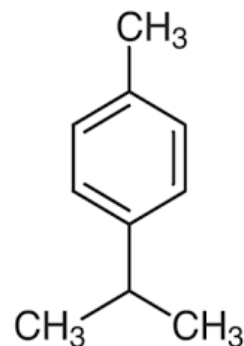


Figure 23. P-cymene synergist effect with Carvacrol

The synergistic in vitro effect of p-cymene plus Carvacrol could suggest using the combination in inhibiting *Vibrio cholerae*, a gram-negative bacterium, and other foodborne pathogens in food. Para cymene is effective against pathogenic bacteria, especially *Escherichia coli*.

p-Cymene has potential in the prevention of protein glycation mediated diabetic complications has also been confirmed, and it has been suggested as an in vivo antioxidant compound due to its ability to reduce the formation of oxygen and nitrogen reactive species, acting as a potential neuroprotective agent in the brain. Therefore, it could be involved in the treatment of oxidative stress-related diseases. α -thujene prevents oxidation damage to other molecules in the body, slowing down the aging process.

The synergistic in vitro effect of p-cymene plus Carvacrol could suggest using the combination in inhibiting *Vibrio cholerae*, a gram-negative bacterium, and other foodborne pathogens in food. Para cymene is effective against pathogenic bacteria, especially *Escherichia coli*. This is evident from the study "Carvacrol and p-cymene inactivate *Escherichia coli*. Medicinally, p-cymene is used to prevent coughs and eliminate phlegm. It is "generally recognized as safe" (GRAS) by the U.S. Food and Drug Administration.

The compound, α -Thujene (Figure 24), also demonstrates antibacterial activities. It was observed *in vitro* on four gram-negative and three gram-positive strains and slowed bacterial growth. Alpha-terpineol and terpineol have antiseptic and antibacterial properties. Alpha-terpinene is closely related to tea tree oil and yields many of its same benefits, such

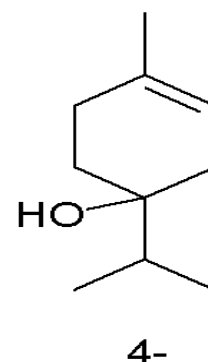


Figure 24. alpha-terpinene

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as an antiseptic healer and antibacterial remedy. Alpha-terpinene aid in fighting off bacteria and boosting the immune system.

Antifungal. Carvacrol also appears to be a potent antifungal agent when combined with thymol. Research from 2015 found thymol to be an effective treatment for common Candida fungal infections. When combined with Alpha-terpinene, it is a potent antifungal and inhibits fungus growth (20).

Candida causes several types of infections, including:

- oral thrush
- yeast infections
- infected toenails or fingernails
- athlete's foot

Antioxidant. Carvacrol is also a potent antioxidant. Antioxidants help protect the body from damage caused by oxidative stress and free radicals. Oxidative stress may lead to increased DNA damage and cell death. Oxidation may also play a role in other issues, such as arthritis, atherosclerosis, and cancers. Thymol (Figure 25) and Carvacrol (Figure 21) are potent antioxidants that may help reduce oxidation. The researchers suggested that further studies explore safe doses for regular use. Gamma terpinene (Figure 26) compounds (including γ -terpinene) are antioxidants. They are also ACE inhibitors, which means they could help keep the heart healthy.

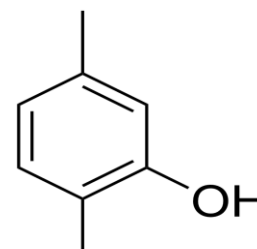


Figure 25. Chemical structure of thymol

Anti-inflammatory. Research from 2017 looked at a variety of investigations into Carvacrol's anti-inflammatory effects. In one study on mice, the compound prevented obesity by affecting the genes involved in inflammation. In another animal study, the compound reduced swelling. p-Cymene also acts as an analgesic/antinociceptive and anti-inflammatory and has a vasorelaxant effect in rat mesenteric artery and aorta. Myrcene has powerful pain and bodily discomfort action acting as a powerful muscle relaxant. There is some evidence that Carvacrol may be an effective pain reliever. An animal study found that Carvacrol

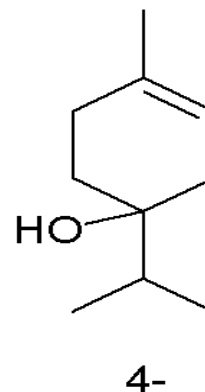


Figure 26. terpinen-4-ol

Cuts and Scrapes. Applying diluted Carvacrol to the skin may help protect smaller cuts and scrapes on the skin as they heal. Compounds such as thymol and Carvacrol could protect these types of a wound from bacterial infections. Researchers have found that Carvacrol, the main compound disrupts part of the process that leads to the creation and accumulation of fat tissue.

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Anti-viral. α -thujene has strong action, and direct virus inhibition of HSV-1 was reported for several monoterpenes (α -terpinene, pinene, p-cymene). The viral envelope was suggested as the potential target of essential oils given the oil's lipophilic nature that enables it to penetrate membranous structures and, consequently, controls the virus entry. There have been intense investigations for their inhibitory actions on the yellow fever virus. The compound terpinen-4-ol, terpinolene, and α -terpineol inhibited influenza A/PR/8 virus subtype H1N1 possess much higher activity than any individual compounds available in its composition.

Cancer. Some sources claim that Carvacrol may help fight some cancers. One author noted that Carvacrol helps prevent some types of colon cancer and breast cancer from growing in test tubes. The oil also appeared to inhibit the growth of some lung cancer and prostate cancer cells. Gamma terpinene research suggests that terpineol can inhibit cancer growth. India's people have far less cancer than people of industrialized Western countries, even though they may have greater exposure to carcinogens. Matched by age, these lower rates involve different types of cancer, and include: (14,19).

99%+ less prostate cancer

90% less kidney cancer

89% less colon cancer

88% less lung cancer

80% less breast cancer

α -terpinene possesses potent antioxidant properties. α -terpinene has also been researched as a potential cancer treatment. A study conducted by the Tropical Journal of Pharmaceutical Research found that α -terpinene contributed to breast cancer cell growth inhibition. Cancer-Fighting: alpha-terpinene has a powerful antioxidant potency, which research has found to have a strong correlation to anticancer benefits. Also, α -thujene inhibits cancer cell growth.

A study carried out in Lisbon, Portugal, found that thymol extracts might protect people from colon cancers. Researchers in Turkey looked at thymol's effect on breast cancer activity, specifically how it affected apoptosis, cell death, and gene-related events in breast cancer cells. They found it caused cell death in breast cancer cells. (15).

Parasites (Anti-Malarial). In 2017, researchers found that these compounds repelled some ticks and mosquitos. The research included test tube studies and those with human participants. "Spotted bee balm is high in thymol, which has antimicrobial, antifungal, and antiseptic properties and has been used historically to treat ringworm and hookworm infections. (11)

General Health. The two primary chemicals in the Spotted bee balm -- carvacrol and thymol, prevent the breakdown of acetylcholine, the chemical that makes memory possible.

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Unlike a drug now used to prevent the breakdown of acetylcholine — tacrine hydrochloride, thymol and carvacrol are not as damaging on the liver.

"People with Alzheimer's disease seem to suffer both from a lack of acetylcholine (a compound believed to function in the transmission of nerve impulses) and oxidative disturbances in the brain. Nicotine has been shown to help prevent acetylcholine breakdown and have members of the mint family high in carvacrol — including Spotted bee balm" (13).

CONCLUSION

This fantastic and aesthetically beautiful plant has been used medicinally for thousands of years by ancient American cultures. It can be administered in many ways, and its effectiveness is supported by the fact that it is a valued medicinal herb by multiple Native American tribes. The chemical components in the plant are used extensively by modern medicine.

Peer-reviewed research findings illustrate that this plant's whole essential oil effectively treats bacteria than isolated chemical compounds extracted or synthesized. Other findings also show that this essential oil is effective against viruses and parasites.

Be Young Total Health intends to add this powerful essential oil to the repertoire of health-promoting products. It will be called **Zara-thym**TM so that its friends and associated can enjoy its many health benefits. Proceeds from the sale of **Zara-thym**TM and the other Be Young products will be donated to the Heartland research group to help with the ongoing research and discovery research.

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