WEC310

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Distillation of Essential Oils[1]

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A short history of essential oils

Essential oils are volatile, aromatic oils obtained from plants and used for fragrance, flavoring, and health and beauty applications.

Historically, aromatic plants provided important ingredients for perfumes, incense, and cosmetics. They have also been used for ritual purposes and in cooking and medicine. Egyptians used aromatic plant materials to preserve mummies, the Ayurvedic literature of India includes many references to scented substances, ancient Chinese herbalists valued them for their curative properties, and royalty used rare aromatics to perfume themselves and their surroundings. Distillation became an important method of obtaining the healing and fragrant components of various plants and was well-studied beginning in the 18th and continuing in the 19th centuries (Figure 1). In the 1900s, during the time of the industrial revolution, component parts of many essential oils were identified. These components could then be synthesized for use in perfume and flavor industries. The art of using essential oils declined during this time but experienced a re-birth in Europe with aromatherapy later in the century. In recent years, the use of essential oils has increased in many industries and in new applications as awareness of the benefit of naturally derived products grows.

Figure 1. An eighteenth century still from an old monograph by Gildemeister.

Plant anatomy and structure as they relate to essential oil production

An essential oil is the volatile material derived from plant material by a physical process. The plant material is usually aromatic and of a single botanical species and form; some essential oil plants have a different chemical makeup depending on the variety of plant, and the essential oils are correspondingly unique. Like grapes used to make wine, "terroir," or

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the location, soil, climate and weather where the plant is grown, will affect its aromatic properties. The usual method of obtaining essential oils from a plant is through distillation or expression. Distillation is the most common method and may be water distillation, steam distillation or distillation using a combination of water and steam. Expression is the pressing of oil from a plant part: citrus oils are generally obtained from expression of the peels.

All varieties of plants are used, including grasses, annuals, flowers, trees, herbs, shrubs, and mosses. All parts of the plant are used, including bark, leaves, stems, seeds, fruits, blossoms, even roots and rhizomes. Essential oils tend to be derived from volatile oils that the plant produces; these are often terpenes, aldehydes, and oxygenated compounds such as alcohols. Essential oils are more than just the familiar lavender; sources list more than 300 different essential oils and by-products (roberttisserand.com/essential-oils, Rose 1999 and Lawless 1995).

Oil may be in youngest leaves or twigs—new twigs and leaves of citrus trees contain petitgrain, and patchouli oil comes from the young twigs and leaves of the patchouli shrub—and production of essential oil in the plant often coincides with the period of most active growth. Flowers may be used as a source—lavender essential oil comes from the flowering tops of the plants (Figure 2). In many plants, the wood is used and essential oils can be gained from distillation of chipped wood. Tall grasses like lemongrass and palmarosa, or the roots of vetiver grass all contain essential oils often used in perfumery.

Figure 2. Lavender field in Jersey, England.

Some plants yield different oils depending on the part distilled. For example, orange essential oil comes from the peel of the orange fruit and is an inexpensive byproduct of the orange juice industry, while neroli (orange blossom) essential oil is much more valuable and comes from distillation of the flowers of the bitter orange tree. Seeds such as clove, coriander, and black pepper may be shipped to a distillery and stored for distillation at any time of the year. Many woody essential oils come from mature trees and may involve destruction of the tree itself. Sandalwood essential oil comes from the roots and heartwood of a small parasitic tree that must be over 30 years old before oil can be produced. Mysore sandalwood is grown in India, and these trees are now endangered. Rosewood comes from a rainforest tree and is obtained from the distillation of wood chips. Rosewood trees are being over-exploited in the Brazilian rainforest and are a non-sustainable source of wood and essential oils.

There are a number of potential reasons for a plant to produce essential oils, including for their anti-viral, anti-fungal or bactericidal properties. Lemongrass, for example, may have some effect in controlling a variety of bacteria and molds (Figure 3). Aromatic compounds within a plant may also act to attract or repulse certain insects and animals. Some attract insects that will visit the plants and collect pollen on their bodies and then deposit that pollen on the next plant they visit, pollinating it.

History of distillation and essential oil production

Distillation of plants has a long and varied history that includes distillation of alcoholic spirits as well as essential oils. While the product may be different, the process is similar. Egypt, Persia, and India are some countries where distillation was first carried out. It is likely that the first distillations of aromatic compounds were intended to produce distilled waters or hydrosols, and the essential oils floating on top may have been discarded. Turpentine, distilled from pine trees, was one of the first essential oils to be distilled along with juniper, rosemary, and lavender. These distillations likely occurred during the 1500s and were followed by a growth in distillation through the seventeenth and eighteenth

Figure 3. Lemongrass plants.

centuries that primarily involved pharmacists. These apothecaries perfected methods of distillation and studied the nature of essential oils. Later, in the nineteenth century, essential oils were widely used as medicines but gradually became almost more important in perfumes. They also become important ingredients in beverages and foods as flavorings. In the United States, turpentine was the most important and first distilled essential oil, in part due to the enormous areas of pine forests and the need for the product. Other early essential oils included sassafras, wormseed, and wintergreen. Peppermint was produced in large quantities by the 1800s; large-scale production continues, and much is sold for toothpaste. With the advent of chemical production of fragrance and flavor chemicals, essential oils decreased in importance. Recent interest in aromatherapy, natural products, and natural perfumery has led to increased production and interest in these botanical products.

Basics of essential oil distillation

The essential oils within a plant are generally not soluble in water, which means they will float on top of an aqueous (watery) solution. However, they can be carried away from plant material by means of steam applied in a closed container. The steam can then be condensed using cool water, collected in a container and the essential oils separated out as they float on top of water produced by the steam. The water thus left behind is often aromatic because it contains water-soluble fragrant chemicals from the plant. This water is called a hydrosol, but may also be referred to as a hydrolat, herbal distillate, or floral water, the most familiar of which are rosewater and orange flower water.

A basic still consists of three main parts—the boiler, the condenser, and the collector (Figures 4 and 5). The boiler provides heat to the water in which the plant material is placed (water distillation), or the boiler may produce steam that is directed through the plant material, which is placed in a container above the water (steam distillation). In some stills, the steam is generated elsewhere and pumped through the container with the plant material. Some plant materials require water distillations; for example, rose petals will clump when exposed to steam and must be immersed in water where they can move about freely. Other materials work well when packed into a space above boiling water to allow the steam to pass through. Many of the best distillations are carried out slowly over low temperatures. Distillation ceases when aromatic compounds are not detected in the outflow from the still. It is important to maintain a strict control on temperature in order that the botanical material is not burnt, especially in water distillation where the water may run dry.

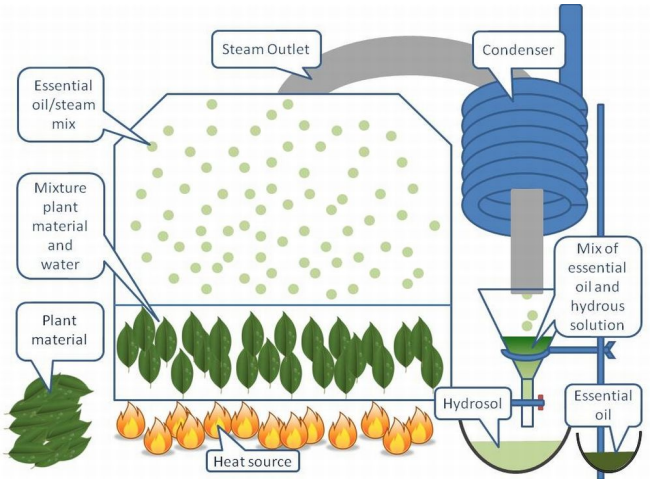

Figure 4. Illustration of still components.

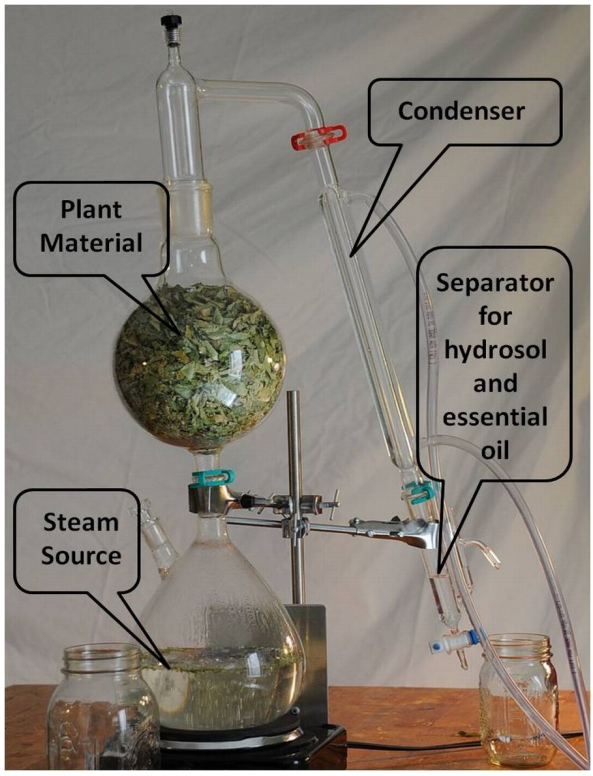

Figure 5. Distillation of palmarosa. Photo by Elise V. Pearlstine.

The steam from either the water or the steam distillation passes through the plant material. As it passes through, it ruptures the sacs containing the essential oils. Essential oils are generally quite volatile and are easily carried into the condenser where a cool fluid, often water, is passed over the collecting tube.

The collecting tube is often coiled and is contained within an outer container through which the cool water flows. This allows the fluid to condense and drip into the collector. In the collector, the essential oil is separated from the hydrosol or aqueous portion. Distillation may take only a few hours or more than 20, depending on the plant being distilled and the method. Both products, the oil and the hydrosol, can then be bottled separately and used in a variety of ways, including aromatherapy, beauty products, room scents, or natural perfumes. If a hydrosol is the final product, the essential oil is generally not removed and is included as part of the product.

References and Further Reading

Arctander, Steffen. 1960. *Perfume and Flavor Materials of Natural Origin.* Published 1994 by Allured Publishing Corporation, Carol Stream, IL.

Firth, Grace. 1983. *Secrets of the Still.* EPM Publications, Inc. McLean, VA.

Guenther, Ernest. 1948. *The Essential Oils Volume One: History-Origin in Plants-Production-Analysis.* D. Van Nostrand Company, Inc. New York, NY.

Gildemeister, E. and Fr. Hoffman 1900. The Volatile Oils. Published by Pharmaceutical Review Publ. Co., Milwaukee, WI.

Lawless, Julia. 1995. *The Illustrated Encyclopedia of Essential Oils: The Complete Guide to the Use of Oils in Aromatherapy and Herbalism.* Harper Collins Publishers, London.

Rose, Jeanne. 1999. 375 *Essential Oils and Hydrosols.* Frog Ltd., Berkeley, CA.