BBLF Lavender Distillation

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BBLF, started in 2020, is 6 miles south of Pullman in southeastern Washington. Our 3.5-acre farm is in USDA hardiness zone 6b on silt loam loess soil with pH 6.5. The farm has 17 lavender cultivars with over 750 plants across our north, south, and west fields.

The following presentation describes our step-by-step lavender distillation process from the field to bottled essential oil and hydrosol.

We use a commercial stainless steel still along with advice and guidance from other lavender growers, our acquired distillation experience, and our personal financial and physical constraints.

Our Distillation Apparatus



Our distillation apparatus has the following components to generate, route, and condense steam to essential oil and hydrosol:

- A **control panel** with heating element to generate steam in a water-filled **boiling tank**.
- A **flexible rubber hose** which carries steam from the boiling tank to the cook pot.
- A **cook pot** where the steam passes through packed lavender stems carrying with it the essential oil vapors.
- A **condenser** where steam is condensed back into liquid form containing essential oils.
- An **essencier** which collects and separates the distillate into essential oil and hydrosol.

Equipment Specs



The Control Panel

Our distillery **control panel** was made by Olympic Distillers in Port Angeles, Washington.

The panel has a single element 220-volt analog heater controller with a 4500-watt element and a manually adjustable amp control dial, for generating steam in the water-filled 50-liter boiling tank.

The control panel along with a 220-volt receptacle are conveniently mounted on the wall next to our shop's overhead door.

Equipment Specs



100-Liter Cook Pot



50-Liter Boiling Tank

Our **cook pot** and **boiling tank** were made with high gauge, food grade 304 stainless steel by Olympic Distillers, in Port Angeles, Washington.

Stainless steel equipment is a popular, durable choice for distilling lavender essential oil and hydrosol. It resists rust, is easy to clean, and does not react with the mild acidity of plant hydrosols the way some metals can.

Both the swan neck connected to the cook pot and the boiling tank have **thermometers** for monitoring temperature during steam distillation.

Equipment Specs



Flexible Connector Hose



Portuguese Essencier

The orange Alfagomma (BREWT T422LH) **flexible rubber hose** carries steam from the boiling tank to the cook pot. The high-purity chlorobutyl (FDA compliant) tube material does not impart odors to the steam. The orange abrasion resistant cover is designed for easy cleaning and sanitation.

The **Portuguese copper essencier**, which has a 3-quart distillate capacity, automatically separates essential oil from hydrosol. The unit has two outlets—a lower front spout for the heavier hydrosol and an upper tube for the lighter essential oil that floats to the top. Portuguese essenciers can be purchased from Iberian Coppers LDA.

Distillation Platform



We built a reinforced 48x84-inch **portable platform** for our assembled distillation apparatus.

The platform, which has 5-inch casters, was cut from ¾-inch plywood.

When distilling we roll the platform into position near our shop's open overhead door. The portable platform is stored in the shop when we are not distilling.

Our Distillation Process



In a nutshell, this is our distillation process:

1. Cut lavender at peak bloom and oil concentration.
2. Load and firmly pack the cook pot with lavender flower stems.
3. After filling the boiling tank with well-water, turn on the control panel to bring the water to a boil producing steam.
4. Steam lavender buds in the cook pot to remove and vaporize the essential oil.
5. Cool vapor in the condenser turning the vapor back into a water and essential oil distillate.
6. Collect the distillate in the essencier which separates it into essential oil and hydrosol.

Timing Distillation Harvest



We harvest lavender for essential oil distillation when 50% to 100% of the flower buds (calyxes) are open, or when about half to nearly all blooms are in full flower. At this stage, the concentration of essential oil in the buds and flowers is at its highest.

Our distillation season starts in July. We harvest the lavender flower stems in the morning after the morning dew has dried, but before the midday heat sets in, to prevent the volatile oils from evaporating. The fresh lavender stems are distilled immediately after harvesting to maximize oil yield.

Cutting Stems for Distillation



When **cutting lavender for bundles**, we cut stems leaving approximately 2-inches of green foliage above the woody stems. This harvest objective maximizes the bundle length, while also serving as an annual pruning.

When **cutting lavender for distillation**, we cut stems to include only the flower head and a short section of stem. This harvest maximizes the number of stems we can pack into the cook pot for each distillation. Lavender essential oil is extracted almost entirely from the flower buds, while the stems contain very little to no commercially usable essential oil.

In August, we return to the field to prune the plants which were cut for distillation.

Loading The Cook Pot



Fill and Pack the Cook Pot



Cover the Cook Pot

First, a **<u>metal mesh screen</u>** is placed in the bottom of the cook pot so lavender stems sit above incoming steam.

The cook pot is then filled in gradual layers rather than dumping all lavender stems in at once. The stems are firmly pressed down so there are no large air pockets, especially around the outer edges of the pot. If the pack is too loose, the steam will rush through empty channels without extracting the oil. If it is packed too tightly, the steam will cause uneven or blocked distillation.

The cover with attached swan neck and condenser is then placed on the cook pot and locked down so vapor escapes only through the attached condenser.

Distilling Our Lavender



The following sequence describes the key events, timing, and observations when distilling our lavender. The distillation starts after lavender stems have been harvested and packed into the cook pot.

1. For the 1st distillation of the day, the 50-liter boiling tank is filled with well-water to the shoulder. This water level is sufficient for 5 to 6 distillations.

   The control panel is then turned on and set to 20-amps. The 220-volt heating element brings the water to a boil in about 55-minutes.

   Our boiling point, which decreases with increasing elevation above sea level, is 209º Fahrenheit in Johnson, WA.

Distilling Our Lavender



2. Two **garden hoses** are then attached to the condenser. The 1st hose is attached to the shop's water spigot and the other end to the bottom of the condenser. The 2nd hose is attached to the top of the condenser with the other end extended outside the shop for draining water. The water spigot is turned on low so well-water trickles through the condenser.

3. The swan neck temperature on the cook pot reaches 180º Fahrenheit in approximately 30-minutes. The distillation is then run for 45-minutes to extract a vast majority of lavender essential oil by steam distillation. The swan neck temperature reaches about 198º F during the distillation.

Vapor Escaping Condenser

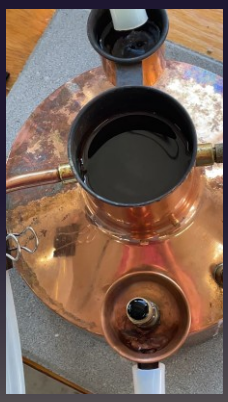


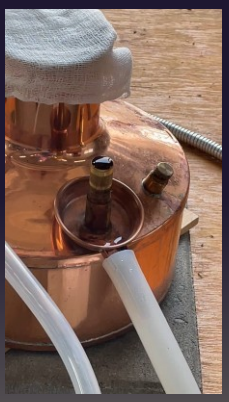
The control panel is initially set at 20-amps to boil the water in the boiling tank and produce steam to vaporize the essential oil inside the lavender buds.

During the distillation, when the condenser is unable to cool the vapor back into a liquid distillate, the vapor escapes from the condenser as steam. In response, we slowly lower the amps to reduce the temperature and heat output of boiling tank to stop vapor from escaping. With less steam being produced, the vapor travels through the cook pot and enters the condenser at a much slower rate, and the vapor then cools back into a liquid.

At completion of the distillation the control setting has typically been slowly turned down to 14 to 15-amps.

Collecting Distillate





Essencier Separating Essential Oil and Hydrosol

The essencier is empty before the 1st distillation of the day or when switching to a new lavender cultivar.

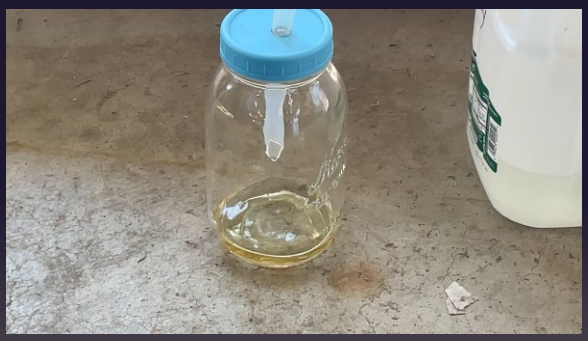
As vapor condenses during the first distillation, the distillate enters the essencier's small reception cup and moves into the primary separation chamber.

Subsequent distillations during the day fill the essencier with distillate, and at that time the essencier will start to passively and nearly instantly separate essential oil from hydrosol.

Separating Oil And Hydrosol



Essential Oil & Hydrosol



Essential Oil

The essencier separates essential oil from hydrosol in real time during the distillation using a dual-chamber gravity design.

The **heavier hydrosol** settles to the bottom and discharges through the lower front spout into its sealed plastic collection container. To reduce the risk of contamination, the spout is connected to the container with rubber tubing.

The **lighter essential oil** floats to the top of the liquid column in the essencier until it reaches the level of the side copper tube, flowing out into a sealed glass bottle. Again, to reduce the risk of contamination, the copper tube is connected to the sealed glass bottle with rubber tubing.

Post-Distillation



Distilled Lavender Stems



Handling Lavender Stems

The control panel is turned off after completing the 45-minute distillation.

The cook pot is allowed to cool down for 30 to 45-minutes before removing the its cover and contents. After extracting essential oil the distilled lavender stems are a now a dull grey-green color and are steaming hot.

For safety, we use **heavy-duty leather gloves** and a pair of **hand-held metal claws** for handling the hot cook pot and its contents.

Post-Distillation Cleaning



Remove Distilled Stems



Clean Cook Pot

The hot distilled lavender stems are removed from the cook pot using the heavy-duty leather gloves and hand-held metal claws. The stems are placed in a plastic bin which is then dumped into our burn pile. The cook pot and its metal mesh screen are cleaned in preparation for the next distillation.

The next distillation is started after refilling the cook pot with fresh lavender stems. The control panel is turned back on to 20-amps, and the pre-heated water now at 175º is boiling and producing steam in about 10-minutes.

Emptying Essencier



Transfer Contents



Essencier Contents

The essencier is emptied after the day's final distillation or when switching to a new lavender cultivar. The distillate is emptied into a plastic bottle using **rubber tubing** attached to the essencier's drain portal. The layer of material that rises to the top of the liquid after the essencier is emptied is composed of plant waxes, resins, and lipids. That layer of material is filtered out using a **coffee filter** and discarded.

The remaining liquid is left to form a new layer of essential oil floating on hydrosol. The essential oil and hydrosol are separated, filtered, and saved in separate containers.

It is recommended that you wear **vinyl gloves** when working with the oil and hydrosol as it can be damaging to your skin.

Cleaning Essential Oil



Filtering Essential Oil



100% Pure Essential Oil

All **essential oil** collected during the day from multiple distillations of a single lavender cultivar are combined, filtered using a coffee filter, and stored in **clear glass Mason jars** which are sealed with **stainless steel silicone lined caps**. The bottles are labelled with the cultivar's name and the distillation date.

Essential oils are highly concentrated, volatile organic compounds, while water-based hydrosols are water-based products containing trace elements of those oils. Stainless steel silicone lined caps are used for both essential oils and hydrosols because they offer maximum chemical resistance, prevent evaporation, and eliminate contamination risk.

Cleaning Hydrosol



Filtering Hydrosol



100% Pure Hydrosol

Hydrosol collected during the day from multiple distillations of a single lavender cultivar are combined, filtered using a coffee filter, and stored in clear glass Mason jars which are sealed with either stainless steel with silicone liners or red/purple/orange **polypropylene (PP) caps with silicone liners**. The bottles are labelled with the cultivar's name and the distillation date.

PP caps are safe, durable, and chemical-resistant for storing water-based hydrosol. Hydrosol is highly prone to bacterial contamination, oxidation, and aroma degradation if not sealed with airtight materials. PP caps, however, have been reported to break, crack, or strip threads over years of heavy use, and therefore, should only be used for short term storage.

Storing Essential Oil & Hydrosol



Protecting essential oils and hydrosols from heat, light, and oxygen is essential to prevent chemical breakdown, loss of therapeutic value, and skin irritation from oxidation.

Our oils and hydrosols are stored in clear glass bottles in a basement room at ≤68º Fahrenheit to protect them from heat. With clear glass bottles we can more easily monitor for possible contamination.

The door to the basement room is closed, the room has no outside windows, all lights and heat are turned off, and the storage shelves are covered with black plastic for protection from light and oxygen.

Bottling Essential Oil



Bottling Supplies



Pipetting Oil into Bottle

Essential oils can degrade plastics and are sensitive to light. Therefore, we use amber 10-ml glass bottles to protect essential oil from UV light.

Before Carol transfers essential oil, all supplies including bottles and caps in her **laminar flow hood** are sprayed down with **95% alcohol** to kill bacteria. She then **aseptically** transfers oil in the laminar flow hood from its stored glass Mason jar to each amber 10-ml glass bottle using a plastic pipette. The white trays are **test tube holders** and hold the bottles securely, preventing them from tipping when being filled.

Carol's background is bacteriology and plant tissue culture, and therefore, she chose to use her home tissue culture lab to bottle our products aseptically to prevent potential contamination.

Bottling Essential Oil





We use glass bottles fitted with orifice reducers which are also called **dropper inserts**. Before capping, Carol places and secures dropper inserts in the bottle opening to control the user's pour rate and limit air exposure. The bottles are then tightly sealed with **locking caps** to prevent volatile aromatic compounds from evaporating and contamination.

The 10-ml glass bottles of essential oil are labeled and then stored upright in a cool, dark, and dry location without direct sunlight and large temperature fluctuations. Lavender essential oils typically last for 2 to 4-years when stored properly in 10-ml amber glass bottles.

Essential Oil Contamination



Lavandula angustifolia

Monitoring for contamination or poor quality in amber 10-ml glass bottles of Lavandula angustifolia essential oil requires both visual and aroma checks.

1. **Abnormal Aroma** – Essential oils should smell floral, sweet, fresh, and herbaceous.
2. **Color & Clarity** – Pure essential oils should be colorless to pale yellow.
3. **Greasy Residue** – Pure essential oils are volatile and should evaporate quickly leaving no persistent ring on paper after an hour.
4. **Abnormal Chemical Constituents** – 100% pure oil should not smell like camphor found in Lavandula x intermedia species.

Essential Oil Contamination



Lavandula x intermedia

Specific chemical, physical, and sensory signs indicate contamination or poor quality in the amber 10-ml glass bottles containing adulterated, diluted, or spiked Lavandula × intermedia essential oils.

1. **Aroma Shift** – Essential oils should not smell overly flat, synthetic, or intensely medicinal /petrochemical instead of sharper and more camphoraceous.

2. **Lack of Depth or Persistence** – Oils diluted with odorless or low-cost carrier oils (like vegetable or mineral oils) or bulk glycols often leave an oily residue on paper or feel unusually heavy and slow to evaporate.

Bottling Hydrosol





Water-based hydrosols have completely different storage and packaging requirements compared to essential oils.

We use amber 16-oz glass bottles to block light, which degrades aroma and active compounds. Glass also does not react with plant compounds or leach chemicals into the water.

Regular or wide mouth **Cruet pour spout silicone inserts for Mason jars** are used to transfer hydrosol from the stored glass Mason jars to the amber 16-oz glass bottles.

Bottling Hydrosol





Before transferring hydrosol, all supplies including bottles, pour spouts, and caps in the laminar flow hood are sprayed with 95% alcohol to kill bacteria.

Carol then uses aseptic technique in her laminar flow hood to transfer hydrosol from its glass storage bottle into the amber 16-oz glass bottles. The cruet pour spout is tightly screwed onto the hydrosol glass storage bottle, hydrosol is carefully poured into the amber 16-oz glass bottle, and the bottle is then tightly capped.

The amber 16-oz glass bottles of hydrosol are stored upright in a cool, dark, and dry location without direct sunlight and large temperature fluctuations. Properly stored unopened lavender hydrosols in amber 16-oz glass bottles typically last up to 2 years.

Hydrosol Contamination



Lavandula angustifolia

Water-based hydrosols have no anti-bacterial activity, and therefore, are highly prone to bacterial and fungal growth. Therefore, they should be checked routinely for contamination. The following are signs of contamination in 16-oz amber glass bottles of Lavandula angustifolia:

1. **The Bloom** – A floating white stringy mass or dark blob hovering near the bottom
2. **Clarity** – Hazy, cloudy, or milky suspension throughout the bottle.
3. **Scent Profile** – Sour, musty, cheesy, wet cardboard, or fermented yeast notes.
4. **Sediment** – Fine dregs or particulate matter settles at the base of the bottle.

Hydrosol Contamination



Lavandula x intermedia

The following are signs of contamination in the amber 16-oz glass bottles containing Lavandula x intermedia:

1. **Visual Indicators** – (a) a bloom cloud-like colony of suspended bacteria or yeast, (b) flakes or sediment of white, grey, or black specs at bottom of the bottle, (c) clear liquid becomes cloudy or milky, and (d) a thin, shiny, or slimy layer forms on the top surface of the liquid.

2. **Scent Changes** – Loss of camphorous top notes and developing off-odors resembling vinegar, sour milk, stagnant water, or wet socks.

3. **Chemical/Physical Changes** – (a) an acidic pH not between 4.0 and 5.5, and (b) potential skin irritation.

Pruning Post Distillation



When cutting lavender for distillation we cut stems to include only the flower head and a short section of stem. In August, we returned to the field to prune the plants cut for distillation.

This August pruning occurs at least 6 weeks prior to our first freezing temperatures. Stems are cut leaving 2-inches of green foliage above the woody stems. In addition, dead and low hanging branches are cut and removed to promote better air circulation and prevent disease. The pruning results in a mound shaped crown which helps prevent winter damage.