

## RSO 2.0 – A Classic Recipe Updated - **PreRelease**



Forward.....	2
Introduction.....	3
Steps in Making Oil.....	5
Decarb.....	6
Wash.....	7
Silting.....	9
Winterize.....	10
Distill.....	11
Collect.....	15
Filter.....	16
Reduce.....	17
Conclusion.....	19
Appendix A – Residual Solvent Lab Reports.....	21
Appendix B – List of Equipment used in this paper.....	24
Appendix C – Setting up the N95 Mask.....	26
Acknowledgements.....	27
References.....	28

**Call for Review from Feb 1<sup>st</sup> to Feb 25<sup>th</sup>**

If you wish to contribute, use Adobe Acrobat to add highlights and comments to this .PDF, then email it to [CannabisHomeSciences@gmail.com](mailto:CannabisHomeSciences@gmail.com) . Your input is greatly appreciated. If you are reading this after Feb 25<sup>th</sup> 2022, please [[DOWNLOAD](#)] the released version.

## Forward

Kudos to Doug on his new site and for taking the time to dig into the details surrounding extracting and processing cannabis essential oils! Especially approaching the process from the viewpoint of ma and pa home processors on limited budgets, forced to grow and process their own meds.

When I first got my OMMP medical marijuana card in 2007, the medical properties of cannabis were considered by the general public to be a wink, wink, nudge, nudge issue and the state of the art was Rick Simpson Oil. Through our group efforts we expanded processing techniques and by 2021 there is a panoply of choices and no question of cannabis medical properties by the informed. Most recently cannabidiolic acid (CBDa) has been identified as impeding the ability of Covid 19 virus to enter human cells.

Following adult usage legalization, extensive focus fell on both recreational and medical products, but alas little focus on poor ole ma and pa who can't afford dispensary products and so must continue to grow and process their own with minimal equipment.

Accolades to Doug especially for thinking outside the box and after learning the tried-and-true path from us older processors, not following it and developing several unique approaches to cannabis processing, easily available to low budget processors and which he shares here.

He uses Isopropyl alcohol, which is readily available and cheap compared to heavily taxed Ethanol. His unique processing removes undesirable contaminants and ensures that there is no residual Isopropyl alcohol in the final product.

James (JD) Ellis, aka Graywolf

## Introduction

Many thanks to [Gray Wolf](#) for his supporting advice to yet-another enthusiast in repeating everything he has covered in the past; his advise has been instrumental. Links to his informative site are sprinkled throughout this paper. Please visit [www.GrayWolfsLair.com](http://www.GrayWolfsLair.com) for an in-depth technical discussion on cannabis oil extraction hardware and procedures.

In the early 2000's, Rick Simpson brought the healing quality of cannabis oil to the masses using simple extraction techniques. In the larger picture of extraction processes, this methodology is simple and oils are crude. This paper focuses on updating the process to make cleaner RSO at home using simple consumer kitchen tools. Here is a quick view illustrating the differences 20 years makes.

Illustrating 20 Years  
of progress in  
extraction  
techniques.

STEPS TO OIL	WASH	STRAIN	SILTING	WINTERIZE	DISTILL	COLLECT	FILTER	REDUCE
RSO V 1.0	Y	Y			Y			Y
RSO V 2.0	Y	Y	Y	Y	Y	Y	Y	Y

Given the goal of reaching consumers with the simple kitchen tools, this process foregoes elaborate technologies like vacuum driven distilling or lab styled filtration systems. Simplicity is the overall goal for home users.

Here are some highlights of this cleaner process -

First and foremost is the adoption of Isopropyl Alcohol as the bulk solvent for extraction. The controversy over Isopropyl's use for extraction has been debated ad nauseam for decades, and is given space on the [website](#) for further discussion. The overwhelming advantage is the cost reduction of making safe oil at home using [USP-NF](#) or higher grades of Isopropyl. Now, instead of using a gallon of Ethanol per pound of plant material, this process uses only 2 ounces.

Another novel addition to this process is using saturated salt water, aka Brine, to drive distillation. By using Brine, the alcohol/water Azeotrope is momentarily suspended, changing the dynamics of simple distillation favorably in our advantage. The use of Brine during distillation has been significant at all sorts of different levels:

1. Brine enables low heat extractions for saving terpenes and avoiding unintentional decarbing. Extractions can now be made across a wide range of temperatures starting as low as 48c/120f and upwards to 100c/212f.
2. Water-soluble plant compounds, sugars, etc., are absorbed in the Brine, which normally gets boiled into the original RSO.
3. Residual Isopropyl is completely removed during distillation. After the Isopropyl boils off, the oil is kept at a constant temperature for one half hour to evaporate residual traces of Isopropyl. Suspending the Azeotrope plays a significant role in this by allowing Isopropyl to boil off separately from water.
4. A common problem making RSO is 'burning' the oil on hot devices. This never happens now as oil floats on water. The water buffers the oil from hot metal surfaces. Once the alcohol boils off, the oils naturally separate and float on the water making recovery easy.

Other improvements include:

1. Set aside your coffee filters. Faster, more efficient filtering at home is accomplished using N95/KN95 masks.
2. Adoption of the well known '[Cold Wash](#)' technique helps reduce unwanted plant compounds.
3. Introduction of 'Sifting' for room temperature de-gumming and protein removal.
4. Adoption of the well known '[Winterization](#)' technique removes unwanted fats and waxes.
5. The final purge is made burn-proof using low power warming devices.

Overall, there are now eight steps to make final oil. Each step is presented on the website in video. This paper covers each step in simple instructions. A more complete 'RSO 2.0 Shop Manual' is available that goes much deeper exploration of each step.

The one problem not tackled is the removal of chlorophyll from the oil. Though this is mitigated in [Gray Wolf's cold wash procedure](#), chlorophyll remains present into the final oil. This will be addressed as simple processes evolve, watch this space..

This process has been developed on a small batches over the course of two years, but is easily scaled up for larger extractions. To scale larger, first learn the science behind each step, then the requirements of scale will become apparent.

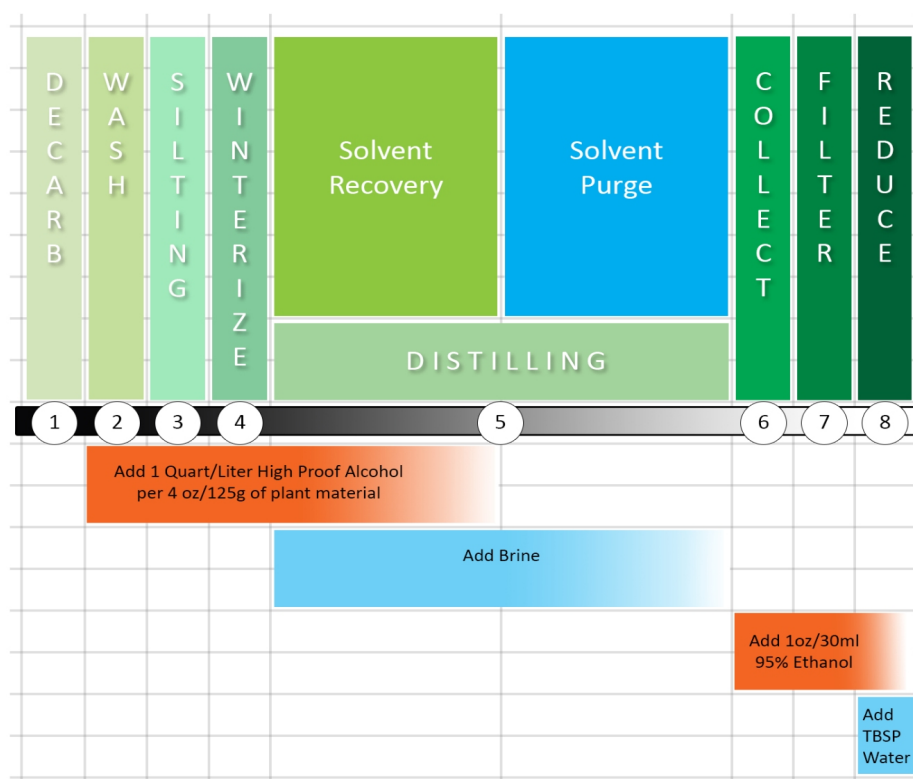
Yields are decreased by nearly 1/3rd – 1/2 from what is normally expected. This makes sense when the trash is removed, the volume goes down, but the concentration goes up. Trading off junk for higher purity is a good trade.

Sprinkled throughout this paper are product links, but all point back to [CannabisHomeSciences.com](https://cannabishomesciences.com). Often products from a vendor will disappear resulting in broken links. Having the product links on the web site allows us to keep the list up to date.

**Warning:** Never use alcohol around open flame. For distilling, always use electric heat to evaporate off alcohol. Devices such as water distillers, crock pots, rice cookers, etc., vent enough alcohol to dangerous levels in enclosed spaces. As a precaution, always perform distillation outdoors in high airflow environments.

## Steps in Making Oil

This new process expands the classic steps of making RSO at home. The illustration below shows all the steps and a timeline when fluids are introduced in the process. A brief discussion of each step follows. There are a set of videos on [CannabisHomeSciences.com](https://cannabishomesciences.com) demonstrating each step.



1. **DECARB.** Activate the cannabinoids.
2. **WASH.** Extract the cannabis oils with Isopropyl.
3. **SILTING.** First pass to clean up proteins and gums.
4. **WINTERIZE.** Second pass to clean up plant waxes..

5. **DISTILLING.** Isolates the oil. First phase isolates the oils and recovers the Isopropyl. Second phase removes residual traces of Isopropyl.
6. **COLLECTING.** Plant water solubles are discarded. Oil and water naturally separate making easy work of collecting oils. Salt is easily purged as well.
7. **FILTER.** Last chance to remove any visible particulates.
8. **REDUCE.** The final step to oil using low heat devices.

**Note:** All the temperatures discussed in this procedure assume sea level atmospheric pressures. Higher altitude may require adjusting the target temperatures.

**Note:** It's highly recommended to follow the practices at each step. Each step will use the results from the prior step, and lends itself to succeeding steps so it makes it much easier to execute.

## 1

### Decarb

#### Theory:

Decarbing heat-activates the cannabinoids by converting the acidic CBDA/THCA into CBD/THC. But sometimes, the acidic state is desirable in final oil. If you wish to save this state, don't decarb at all. Skip this step and the decarbing in step 8.

The heat also disperses the aromatic terpenes. If you wish to save as many terpenes as possible, then wait to decarb in the final step which is done at lower temperature.

To prepare for decarbing, it is recommended the bud be broken up into fine pieces but not pulverized. Pulverizing the plant material will break the surfaces open, allowing unwanted alcohol penetration. These breaks are the primary avenue of access for the alcohol to extract impurities. Gently break the bud apart into 1/3rd inch/1cm pieces; trim is fine as-is.

#### Practice:

In this step, the use of 2l/64oz mason jars is favored as the glass acts like mini Dutch Ovens able to bake the plant material evenly to the core.

Here is an easy procedure for decarbing:

1. Breakup the bud into 1/3rd in/1cm sizes. Trim is fine as-is.
2. Place up to 4oz dry cured plant material into a 2l/64oz mason jar, close the lid.

3. For 'No-Skunk-Zone' compliance, place each jar in loosely sealed oven bags.
4. Place the jar horizontally in an oven, close the oven for the full cycle.
5. Preheat to 115c/240f, then bake for 40 or 60 minutes.
6. When done, turn off the oven and let the jar cool to room temperature.
7. If bagged, vent the bag outdoors. The bags can be reused.

For further discussion, please read Gray Wolf's post on [decarboxylation](#).

You are ready for the next step.

## 2

### Wash

#### Theory:

Isopropyl alcohol is used for its unique chemical nature. It is available in safe [USP-NF](#) and higher grades, is 1/3rd less polar than Ethanol, is faster dissolving oils, and works with simple table salt brine in distilling. More expensive Ethanol works, but takes longer and doesn't react to brine. Though Isopropyl is favored, feel free to use the solvent of your choice for the bulk extraction.

[Cold washing](#) dissolves the desirable cannabinoids quickly and avoids dissolving other plant material. Isopropyl is very efficient in dissolving non-polar oils in very short order. Longer soak times only allow more unwanted polar plant material to be extracted. Here are the wash times reported by Gray Wolf in his [QWISO](#) extraction post:

*With a dielectric index of 17.9, versus Ethanol's 24.5, Isopropyl is less polar, yet is still much more aggressive in extracting both targeted and un-targeted elements. Where we start a 3 minute soak with Ethanol, starting point with Isopropyl is **20 seconds**.*

*Like Ethanol, we address it using subzero extraction temperatures, and address the aggressiveness issue by shortening soak time. We typically yield 75 to 80% within 20 to 30 seconds, and pick up the balance using a second soak.*



The following table is presented to make a point.

Temperature of plant and alcohol	ISO	EtOH
Extraction times at -20c/0f	20 seconds	3 minutes
Extraction times at 20c/68f	20 seconds	3 minutes
Extraction times at 48c/120f	20 seconds	3 minutes

Dissolving oil happens at the same rate across temperature, only water and plant material are affected by temperature. The warmer and longer the soak, the more plant by-products are included in the wash. The recommendation is a 20 second cold wash. For removing the plant material, a [120 micron Nut Milk bag](#) is recommended to separate the plant from the wash. This allows most trichome shells to be passed into the wash for longer soaking. Trichomes provide the richest source of cannabinoids, so its okay to let them soak longer.

On solvent selection, only use [food grade or USP-NF grade](#) alcohol to avoid impurities. The minimum proof should be 190 and above. For home extractors with limited choices on solvents, 151 proof vodka does work with the trade-off of greater impurities and lower yields.

#### Practice:

1. Place the 2l/64oz mason jar and alcohol solvent in the freezer for 4 hours.
2. After 4 hours, pour in enough cold solvent to cover plant material.
3. Agitate for the duration of the soak.
4. Take a [120 micron Nut Milk bag](#) and insert into a [4 quart stainless steel pot](#).
5. Pour the wash through the bag, then lift the bag and shake it to remove excess alcohol.
6. Clean the mason jar, then pour the wash and all trichome shells back in.

The next steps will remove the trichome shells, fats, waxes and any remaining plant material.

For further discussion, please read Gray Wolf's post on [Ethanol](#) Extraction.  
For further discussion, please read Gray Wolf's post on [Isopropyl](#) extraction.

You are ready for the next step.



## Silting

### Theory:

Silting is a term coined to describe a unique way of clarifying the wash. This process comes from food industry for manufacturing cooking oils. A simple form of [Chemical Degumming](#) is performed to remove unwanted proteins and phospholipids (gums) prior to winterization. Proteins are the unnamed contaminants in RSO, typically seen as grit in the final oil. The Silting step uses Lime Juice and simple Club Soda to coagulate then remove impurities through (you heard it here first..) an N95 mask filter.

[Lime Juice](#) has been found to be most effective in coagulating gums and proteins. The catalyst to start the process is water. Club Soda with Bicarbonates is used as the catalyst. Bicarbonates neutralize the citric acid, converting to bubbly CO2 which helps coagulate the impurities in larger, filterable particle sizes. Please visit [CannabisHomeSciences.com](https://cannabishomesciences.com) for further discussion and a list of recommended brands of Club Soda.

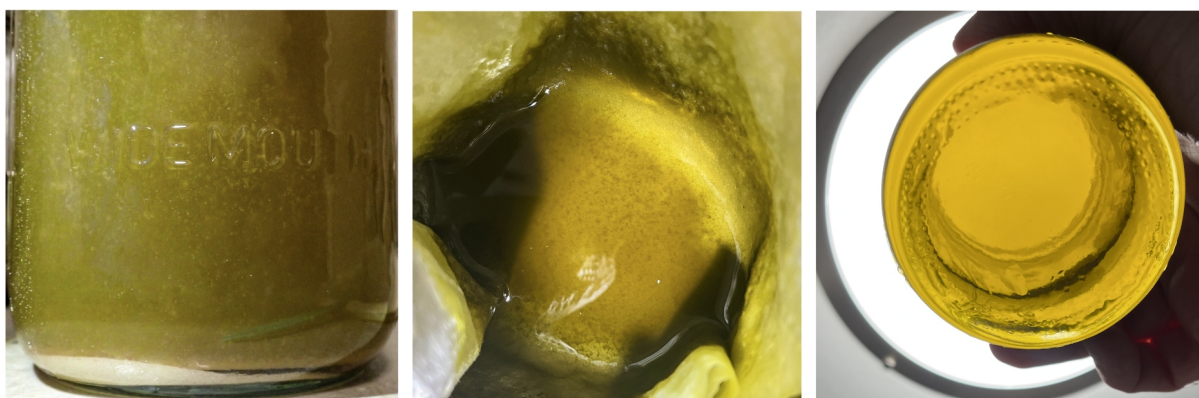
The N95 specifications make N95s an excellent fast filter for home use. Given the amount of sludge produced, a paper towel is used to line the N95 which catches 99% of the mess. You can harvest this waxy gunk for making topicals at a later time.

Please refer to the RSO 2.0 2021 Shop Manual for further information.

### Practice:

1. Take the jar from the prior step, add 1 drop of [Lime Juice](#) per quart/liter of wash.
2. Swirl then let sit for 5 minutes. Some coagulation may be triggered by the water content in the alcohol.
3. For every quart/liter, add half as much [Club Soda](#), then shake.
4. Let sit for 20 minutes.
5. Filter through an N95 mask lined with a paper towel.

Here's what you may see depending on the amount of proteins and gums in the wash. The density is determined by many factors – temperature, extraction time, and quality of source material. Some washes will be thick, some thin, your mileage may vary.



An N95 mask filters out all visible particulates down to the sub micron level, just amazing for a cheap home filtering tool. Always line the mask with a paper towel to catch the bulk of particulates. The masks can be cleaned for reuse by rinsing upside down in hot water.

You are ready for the next step.

4

## Winterize

### Theory:

[Winterization](#) is an idea popularized after Rick Simpson published his oil making procedure. Plant fats and waxes coagulate at freezing temperatures becoming sediment on the bottom of the container. This happens over time in a frozen motionless environment. Home freezers run at -20c/0f, sufficient for this use.

Winterization is done in two very long steps. First is freezing the wash for 12-24 hours, then passing the solution through a frozen N95 filter with paper towel liner. Its important to maintain the freezing temperatures so keep the filter in the freezer. The filtering is slowed down because Isopropyl thickens at low temperature.

Given the filter only holds about 125ml / ½ cup of wash at a time, you should swap out the paper towel on each pass. Save the gunk filled paper towel if you wish to harvest waxes.

## Practice:

1. Place the 2l/64oz jar holding the solution in the freezer for 12-24 hours.
2. Setup the N95 filter with capture jar in the freezer 1 hour before filtering.
3. Very carefully, pour the jar's frozen content into the filter.
4. Let the filter drain completely. If full of wax, swap out the paper towel liner.
5. Repeat till done.

For further reading on waxes, please visit Gray Wolf's post on [Plant Waxes](#).  
For further reading on winterization, please visit Gray Wolf's post on [Winterization](#).  
You will find more information on the website and in the RSO 2.0 2021 shop manual about the N95 filter setup.

You are ready for the next step.

5

## Distill

### Theory:

Distillation is a process of separating alcohol from water using heat as a catalyst. In the RSO 2.0 process, heat is now managed. The recommended approach to distilling is using a double boiler on a hotplate or electric stove. Here is a screenshot from the demonstration video on the website.



The double boiler approach allows the distilling temperature to be maintained at a constant level. This example is running at 82c/180f. The above image shows a double boiler setup that doesn't recover the alcohol. If you have large batches or wish to recapture the alcohol, then a [small stove top still](#) is in order. Again, its all about controlling the temperature. Crock Pots, Rice Cookers and Water Distillers are harder to control the input heat; you get whatever the device is designed to deliver. See the Shop Manual for further discussion on how to make these devices work.

In the past, water has been avoided until the final purge. Its presence now, as brine, plays a big role in separating the oil. Brine is a force multiplier when it comes to separating Isopropyl from water. The alcohol will be “[Salted-out](#)” of its watery bonds, suspending the [Azeotrope](#) while in liquid form. When heat is applied, the alcohol boils off leaving floating oil on the brine waste water. The brine acts as a buffer keeping the oil elevated off the hot metal.

With the oil safe from overheating, and the Isopropyl/water Azeotrope suspended, its only a matter of time for 100% of the alcohol to evaporate off. This can be done as low as 48c/120f.

There are two phases of distilling - solvent recovery then solvent removal.

### **Phase One: Solvent Recovery**

During this first phase, the alcohol vaporizes leaving the oil floating on brine water. Since The Azeotrope between alcohol and water is momentarily suspended, virtually all the alcohol will boil off, reforming the Azeotrope in vapor that can be recaptured. By using a Still for condensing these vapors, over 98% of the alcohol can be recaptured for later use. By holding the temperature to 82c/180f or below, the pot will stop boiling when all the alcohol has evaporated. The heat will cause the Brine to swirl around, but the bubbling will stop. When this happens, Phase 2 begins.

### **Phase Two: Solvent Removal**

Phase two works just like phase one. Heat is held at 82c/180f allowing extra time for removing any traces of alcohol. 30 minutes has shown to be enough time to flush all residual alcohol. Remember, the Azeotrope is suspended by the salt so there's nothing holding the Isopropyl in the water.

**Warning:** Again it's worth saying over and over: Never distill alcohol around open flame. Always use electric heat to boil off alcohol. As a precaution, always perform distillation outdoors or in high airflow environments.

### **Practice:**

Alcohol recovery is important when using expensive Ethanol, less so for inexpensive Isopropyl. For those wishing to recover the alcohol, a [small stove top still](#) is recommended; otherwise, a double boiler can be used. Both approaches are presented below.

## Open Double Boilers



**Warning:** This type of boiler allow alcohol vapors to dissipate in open air. Alcohol vapors are highly flammable, so always distill your wash where there is ample fresh air flow, preferably outdoors, but never in confined spaces.

Here's the workflow:

1. Fill the bottom boiler pan 3/4s full with tap water.
2. Place it on the hot plate then go to full power.
3. Once boiling, turn down the power to the lowest setting.
4. Mix enough brine to fill 1 inch of the top pan. Brine is 4 parts water, 1 part salt. Add 60g / 1/4cup salt to 250ml / 1 cup distilled water. Pour both brine and wash into the top pan.
5. Place the top pan in the boiler. Phase 1 has begun.
6. Maintain 82c/180f to allow the alcohol to boil off.
7. Once boiling stops, Phase 2 begins. This phase removes any remaining Isopropyl from the oil. If you used ethanol, you are done. Add ice to the pan and move to the next step.
8. Maintain 82c/180f for 30 minutes.
9. At the end of 30 minutes, power down. Add ice to freeze the oils, then you're ready for the next step.

You are ready for the next step.

## Moonshine Still



The preferred tool for distilling is a simple [Moonshine Still](#) on a hot plate. This tool is engineered from the start for recovering alcohol. A Still comes with a built-in temperature gauge for monitoring the entire distillation process. You will be “Flying by Instrument” with only the temperature gauge to guide you from beginning to end.

Here's the workflow:

1. Mix enough brine to fill 1 inch of the boiler. Brine is 4 parts water, 1 part salt. Add 60g / 1/4cup salt to 250ml / 1 cup distilled water. Pour in both the brine and wash, close the lid, then power up to full power.
2. Closely monitor the temperature as it rises to 65c / 150f, then cut the power in half.
3. Once the temperature reaches 76c / 170f, Phase 1 has begun. Reduce the power to its minimal setting.
4. Maintain the heat between 76c / 170f and 82c / 180f for the duration. Alcohol will vaporize, re-condense, then drip into the capture jar.
5. Once the dripping stops, Phase 2 begins. This phase removes any remaining Isopropyl from the oil. If you used ethanol, you are done. Let the boiler cool down so you can pour in ice, then move to the next step.
6. Maintain the heat between 76c / 170f and 82c / 180f for 30 minutes.
7. At the end of 30 minutes, power down.
8. Place the boiler in a bucket of cold water. When cooled down to 48c / 120f, open it up and add ice to freeze the oils.

You are ready for the next step.



## Collect

### Theory:

Oil recovery from a brine solution is unique to this process. The picture below shows the floating oily tar at the end of distillation for both devices. This oil will be a mix of oils, waxes, and resins. For purposes of brevity, this mix will be called “tar” in this section, which is very fitting. RSO and FECO are even stickier tars.



Double Boiler



Still

After distillation, the black tar will be floating or adhered to the sides of boiler. The brine waste water is comprised of salt and water soluble plant material. 99.99% of the salt will remain in the water, with maybe some salt dried on top or covered over by tar. Collecting the tar is simple enough. By adding ice to the boiler, the tar thickens and accumulates on the metal surfaces. Any floating oils can be captured by pouring the waste water through a nylon coffee strainer basket.

### Practice:

The tar is very heat sensitive. Add ice to the boiler and it will harden.

1. Pour the waste water and ice through a [nylon coffee strainer basket](#) into another container. No paper filter needed, we want to leave the tars sitting on the nylon.
1. Add cold water to the boiler and gently swirl to rinse out the brine.
2. Pour the water through the [nylon coffee strainer basket](#) into a container.
3. Place the coffee strainer in a 2 cup stainless steel bowl.
4. Pour 30ml / 1oz warm Ethanol into the coffee strainer which will pass into the bowl. large extractions may need another 30ml / 1oz.



5. Use a silicone spatula to spread the alcohol across all the tar, then lightly rub the alcohol into the tar until it completely dissolves. Turn the basket on its side in the bowl and rotate it through the alcohol. The alcohol will do the hard work. Just keep spreading the alcohol across the tar, rubbing it in gently. This will take a bit of time, so take your time.
6. Once the basket is clean, pour the bowl into the pot with the tars, repeat.

You are ready for the next step.

7

## Filter

### Theory:

This step is optional. This is your last opportunity to filter out residual impurities before reducing down to oil. If you can see any particulates in the wash, you might consider filtering it now but realize, any filtering at this point might lower the yield.

Here we use [flat coffee filter paper](#) in the strainer basket. Coffee filters are much slower but will catch more particulates than paper towels.

### Practice:

If you wish further purification, place the Solution in the freezer for 12 hours. This gives waxes and sediments time to chill and settle out of the Solution.

Here's the practice -

1. For best results, place the Solution in the freezer for 12 hours.
2. Setup nylon coffee strainer basket with a paper filter,
3. Place the basket in the N95 filter in lieu of a paper towel.
4. Pour the Solution through the paper filter, wait for the Solution to completely drip through.
5. Pour the jar contents back into the small bowl for the next step.

You are ready for the next step.

## Reduce

### Theory:

This is the last step for final oil. Historically, this step has been the weakest link in creating RSO as its unclear when the reduction has completed since there are few clues when the ethanol and water have completely evaporated. Gray Wolf [has given](#) the best description so far published on the subject

*Alcohol bubbles are larger and highly variable in size, and once they stop popping, you will note the continuation of small equally sized fizzy bubbles, which is the CO2 being given off by decarboxylation.*

*At approximately 70% decarboxylation, bubble production will suddenly drop off, and it is at that point that you have the highest total THC content. As you continue to decarboxylate, the remaining THCA and CBDA are converted to THC and CBD at a lower rate than THC and CBD are converted to CBN.*

The purpose of this step is to evaporate off the Ethanol and any remaining water using evenly applied low heat. Though this can be accomplished using all sorts of low heat devices, this paper showcases two low cost, low power units for the final reduction. Lower heat avoids losing terpenes and unintentional decarboxylation.



25 watt coffee  
cup warmer

35 watt Little  
Dipper Pot.

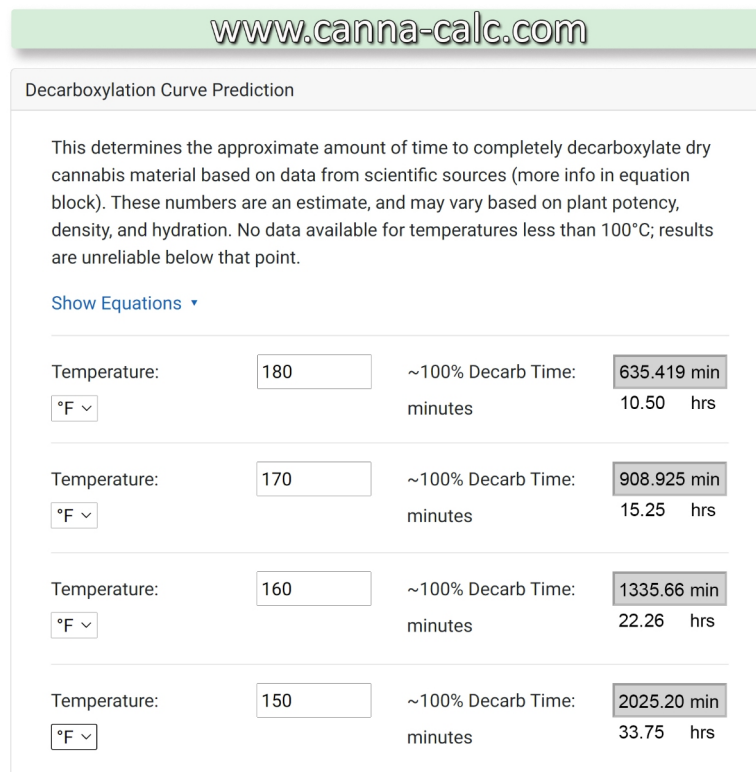
Both devices can be used as an oil bath double boiler. This delivers even, consistent heat, avoiding hot-spots that burn any remaining impurities. Both devices used in this configuration can maintain sub 82c/180f temperature.

### Practice:

From the prior step, you should have a small dish of dissolved oils in Ethanol.

1. Setup an oil bath on either device. Power up and let warm up for an hour.
2. Place the bowl with Ethanol in the oil bath. The alcohol will evaporate as the mixture reaches higher temperatures.
3. large bubbling occurs as the alcohol evaporates off.
4. Wait till the bubbling subsides. Small fizzy bubble mean decarboxylation is occurring. If you wish to avoid decarbing, then you're done.

For decarbing in this step, leave the bowl in the oil for x amount of hours. The time is determined by the temperature of the oils. Here's a chart with times and temperatures.



After the appropriate number of hours on low heat, you are done.

## Conclusion

Through the use of various simple techniques, cleaner RSO can be made at home. The novel use of brine in this process opens the door to many significant improvements. Brine enables a low heat extraction to save terpenes and avoid unintentional decarbing. It also absorbs water soluble plant compounds which get poured out as waste water. Adoption of Gray Wolf's [Cold Quick Wash with Isopropyl](#) technique helps avoid extracting plant impurities. Silting and Winterization scrub fats, waxes and proteins. All combined resulting in a cleaner RSO product.

Phase 2 of distillation works so well purging residual solvents, it takes the worry out of using Isopropyl. Less expensive Isopropyl can now be used in conjunction with Ethanol, without fear of [Residual Solvents](#) in the final product. Three Residual Solvent reports are provided in the appendices below for substantiating this claim.

Given the huge cost difference between Ethanol and Isopropyl alcohol, using this process slashes the cost of producing RSO at home. The higher specialized pricing of USP-NF Medical Grade Isopropyl is less than half the cost of Ethanol at the retail level.

Silting at room temperature is groundbreaking for home users. This works well enough to skip Winterization when in a hurry to make baseline oil. Silting and Winterizing overlap by crystallizing phospholipids and waxes. Silting addresses phospholipids and gets some waxes. Winterization addresses waxes, and get some phospholipids.

Difficulties in filtering out waxes and trichomes has been a huge impediment for home users. By using an [N95 mask](#) for filtering, this process is sped up.

One of the weakness in making RSO at home, has been around the 'End Game' of reducing down the final oil. This final step is made safe by use of oil baths on low power devices.

Salt intake is a major concern for many medical patients. Using brine during distillation might raise red flags for this audience. The good news is, salt dissolves in water but not in oil; the oil repels both the water and salt. The Collect step captures the oil and rinses out the salt. Further cleansing can optionally be done in the final reduction.

## Observations and future investigations

Future investigation is needed for the following items:

Rabbit Hole #1: Is 30 minutes too much time to evaporate off residual Isopropyl? Given brine suspends the water-alcohol Azeotrope, allowing Isopropyl to evaporate off completely. A half hour might be overkill, the alcohol might be eliminated much sooner.

Done for now, watch this space for future announcements.

## Appendix A – Residual Solvent Lab Reports

Residual Solvents report #1 using Isopropyl Alcohol and a water distillation. This report shows no Residual Solvents in the final oil.



## Analytical Test Report

Science First. ORELAP ID: 4096 OLCC#: 010-1002112892C

7200 Johnson Creek Blvd., Portland, OR 97206 (503) 307-0096

**CBD- 01**

Laboratory ID: 2105164-01

### Residual Solvents

Analysis Method/SOP: RS

Solvent	Results in ppm	LOQ	Action Level	Notes
Acetone	< LOQ	2500	5000	
Acetonitrile	< LOQ	205.0	400	
Benzene	< LOQ	1.000	2	
2-Butanol	< LOQ	2500	5000	
Cumene	< LOQ	35.00	70	
Cyclohexane	< LOQ	1940	3880	
Dichloromethane	< LOQ	300.0	600	
1,4-Dioxane	< LOQ	190.0	380	
2-Ethoxyethanol	< LOQ	80.00	160	
Ethyl acetate	< LOQ	2500	5000	
Ethylene glycol	< LOQ	310.0	620	
Ethylene oxide	< LOQ	25.00	50	
Ethyl ether	< LOQ	2500	5000	
Heptane	< LOQ	2500	5000	
Isopropyl acetate	< LOQ	2500	5000	
Methanol	< LOQ	1500	3000	
Propane	< LOQ	2500	5000	
2-Propanol (IPA)	< LOQ	2500	5000	
Tetrahydrofuran	< LOQ	360.0	720	
Toluene	< LOQ	445.0	890	
Butanes	< LOQ	2500	5000	
Hexanes	< LOQ	145.0	290	
Pentanes	< LOQ	2500	5000	
Xylenes	< LOQ	1085	2170	

Results above the Action Level fail state testing requirements and will be highlighted Red.

A handwritten signature in black ink that reads "ERIK WERSTLER".

Erik Werstler  
Lab Director

Sample tested in compliance with OAR 333-007 (TNI standards). Lab accredited for CBDA, THCA, CBD, THC, and sampling. These results relate only to the sample included on this report. The report may not be reproduced except in full, without the written permission of Rose City Labs.

Page 2 of 7

Residual Solvents report #2 using Isopropyl Alcohol and a water distillation. This report shows no Residual Solvents in the final oil.



## Analytical Test Report

Science First. ORELAP ID: 4096 OLCC#: 010-100211289

7200 Johnson Creek Blvd., Portland, OR 97206 (503) 307-0096

**CBD5/21**

Laboratory ID: 2106103-01

### Residual Solvents

Analysis Method/SOP: RS

Solvent	Results in ppm	LOQ	Action Level	Notes
Acetone	< LOQ	2500	5000	
Acetonitrile	< LOQ	205.0	400	
Benzene	< LOQ	1.000	2	
2-Butanol	< LOQ	2500	5000	
Cumene	< LOQ	35.00	70	
Cyclohexane	< LOQ	1940	3880	
Dichloromethane	< LOQ	300.0	600	
1,4-Dioxane	< LOQ	190.0	380	
2-Ethoxyethanol	< LOQ	80.00	160	
Ethyl acetate	< LOQ	2500	5000	
Ethylene glycol	< LOQ	310.0	620	
Ethylene oxide	< LOQ	25.00	50	
Ethyl ether	< LOQ	2500	5000	
Heptane	< LOQ	2500	5000	
Isopropyl acetate	< LOQ	2500	5000	
Methanol	< LOQ	1500	3000	
Propane	< LOQ	2500	5000	
2-Propanol (IPA)	< LOQ	2500	5000	
Tetrahydrofuran	< LOQ	360.0	720	
Toluene	< LOQ	445.0	890	
Butanes	< LOQ	2500	5000	
Hexanes	< LOQ	145.0	290	
Pentanes	< LOQ	2500	5000	
Xylenes	< LOQ	1085	2170	

Results above the Action Level fail state testing requirements and will be highlighted Red.

A handwritten signature in black ink that reads "ERIK WERSTLER".

Erik Werstler  
Lab Director

Sample tested in compliance with OAR 333-007 (TNI standards). Lab accredited for CBDA, THCA, CBD, THC, and sampling. These results relate only to the sample included on this report. The report may not be reproduced except in full, without the written permission of Rose City Labs.

Page 2 of 7



Residual Solvents report #3 using Isopropyl Alcohol and a brine distillation. This report shows no Residual Solvents in the final oil.



## Analytical Test Report

Science First. ORELAP ID: 4096 OLCC#: 010-1002112892C

7200 Johnson Creek Blvd., Portland, OR 97206 (503) 307-0096

### CBD-Brine-2

Laboratory ID: 2109301-01

#### Residual Solvents

Analysis Method/SOP: RS

Solvent	Results in ppm	LOQ	Action Level	Notes
Acetone	< LOQ	2500	5000	
Acetonitrile	< LOQ	205.0	400	
Benzene	< LOQ	1.000	2	
2-Butanol	< LOQ	2500	5000	
Cumene	< LOQ	35.00	70	
Cyclohexane	< LOQ	1940	3880	
Dichloromethane	< LOQ	300.0	600	
1,4-Dioxane	< LOQ	190.0	380	
2-Ethoxyethanol	< LOQ	80.00	160	
Ethyl acetate	< LOQ	2500	5000	
Ethylene glycol	< LOQ	310.0	620	
Ethylene oxide	< LOQ	25.00	50	
Ethyl ether	< LOQ	2500	5000	
Heptane	< LOQ	2500	5000	
Isopropyl acetate	< LOQ	2500	5000	
Methanol	< LOQ	1500	3000	
Propane	< LOQ	2500	5000	
2-Propanol (IPA)	< LOQ	2500	5000	
Tetrahydrofuran	< LOQ	360.0	720	
Toluene	< LOQ	445.0	890	
Butanes	< LOQ	2500	5000	
Hexanes	< LOQ	145.0	290	
Pentanes	< LOQ	2500	5000	
Xylenes	< LOQ	1085	2170	

Results above the Action Level fail state testing requirements and will be highlighted Red.

A handwritten signature in black ink that reads "ERIK WERSTLER".

Erik Werstler  
Lab Director

Sample tested in compliance with OAR 333-007 (TNI standards). Lab accredited for CBDA, THCA, CBD, THC, and sampling. These results relate only to the sample included on this report. The report may not be reproduced except in full, without the written permission of Rose City Labs.

Page 2 of 7

## **Appendix B – List of Equipment used in this paper**

This list shows all the items used to make oil. The links are intended on giving you a visual picture of the item. Most of these items can be purchased locally at lower prices. A lot of the equipment used over the course of development was acquired at the local Goodwill and dollar stores.

Click [\[HERE\]](#) to access the product links. The links are hosted on the website in order to update broken links as products disappear and new ones come out.

### **Items needed for Step 1 Decarbing:**

2l/64oz Mason jars and lids.  
Optional oven bags to control the aroma.

### **Items needed for Step 2 Washing:**

Enough Ethanol or Isopropyl to cover the plant material.  
4 quart stainless steel Bain-Marie pot.  
120 micron Nut Milk bag.  
Items needed for Step 3 Silting:  
Lime Juice.  
Club Soda with Bi-carbonate such as these:  
    Schweppes Soda Water.  
    Kroger Club Soda.  
    Walmart Club Soda.  
N95 Filter setup, see below..

### **Items needed for Step 4 Winterizing:**

Household freezer.  
N95 Filter setup, see below..

### **Items needed for Step 5 Distilling:**

Measuring cup.  
Iodine free table salt.  
Distilled water.  
Household electric stove or reasonable hotplate.  
Electric cooking temperature or Temperature gun.

**If distilling and alcohol recover is not important:**

Any two stack-able pots to form a double boiler.

**For alcohol recovery during distillation:**

Moonshine Still.  
An aquarium pump for the still's condenser.  
Bucket to hold water for the condenser.  
Additional silicone tubing to hook it all up.

**Items needed for Step 6 Collecting:**

Soft silicone spatula.  
nylon coffee strainer basket.  
1 & 2 cup stainless steel bowls  
Clean tap water or distilled water.

**Items needed for Step 7 Filtering:**

Nylon coffee strainer basket.  
Flat bottom coffee filters.  
N95 Filter setup, see below..  
1 cup stainless steel bowl.

**Items needed for Step 8 Reducing:**

1 cup stainless steel bowl.  
Coffee Mug Warmer or Little Dipper for evaporating the ethanol.  
1ml syringes.  
Amber Storage jar.

**Items Needed for the N95 Filter Setup:**

N95 or KN95 mask with straps.  
5 inch funnel.  
Thin 2-ply paper towels.

## Appendix C – Setting up the N95 Mask

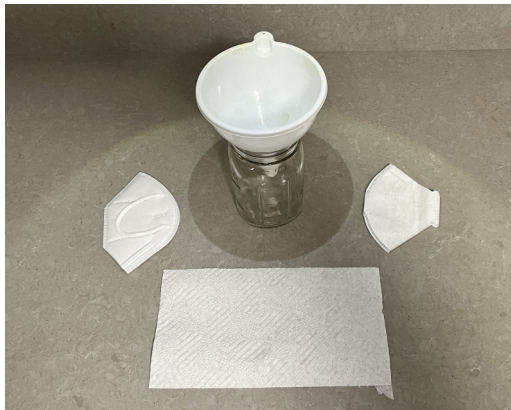
Here are all the necessary pieces:

5 inch funnel

N95 mask with straps

Thin 2 layer paper towel or

N95 insert mask.



Strap the N95 mask on to the funnel.



Line the mask with either paper towel or N95 insert. Wet the insert with alcohol to initiate some flow.



## Acknowledgements

We all owe deep gratitude to passionate people making contributions that improve peoples lives. I want to thank [Gray Wolf](#) for his sound science and engineering, and for making his knowledge available for free to all interested and in need of Medical Marijuana. Please visit [GrayWolfsLair.com](#) for all subjects pertaining to DIY cannabis extraction and application.

And special thanks to Chemist Joe Oakes for steering an ADHD amateur wannabe chemist in the right direction when encountering unknown results.

Special thanks to ThatKeith @ [www.CancerWriter.com](#) for the grammatical review and all the corrections.

The cannabis oil extracted in the following paper is appropriate for direct ingesting, used in a tincture, or baked into foods but not recommended for vape pens. The oils will contain chlorophyll, residual waxes and resins that may cause vape pens to fail. Evaluate your final oil to make your own determination of appropriateness for vaping.

This process is free, open to all. There is nothing proprietary requiring special purchases. Every product used is a consumer product available in stores or online; feel free to use your own equipment. With that said, most product links presented in this paper are Amazon Affiliate links. You are not obligated to use these links, but we are grateful if you did as it helps fund future research.

*“There are no failures, only data points in the larger picture.”*  
...MimiEMU



## References

GrayWolfsLair by James Ellis and Team

[Cannabis oil Extraction using Isopropyl Alcohol - QWISO](#)

[Cannabis oil Extraction using Ethanol Alcohol - QWET](#)

[Decarboxylation](#)

[Rate of THC Decomposition to CBN, et al](#)

[Plant Waxes](#)

[Winterizing to remove waxes](#)

Granny Storm Crows List

[The List of All Things Cannabis](#)

Wikipedia:

[Salt-Effect Distillation](#)

[Salting-Out](#)

Scientific American

[Separate Liquids with Salt!](#)

PubMed: US NIH National Library of Medicine

[Cannabis Study Search Results](#)

PubChem: US NIH National Library of Medicine

[Ethanol](#)

[Isopropyl, aka, 2-Propanol](#)

FDA: US Food and Drug Administration

[Q3C Table List Guidance for Solvent Classes](#)

[FDA's approval](#) for use of Isopropyl in certain food products

[FDA's approval](#) for use of Isopropyl on the human body.

Oregon State Liquor Control Commission Extraction Code

[Chapter 845, Section 3.c.B](#)