From: Doug Cody, aka, MimiEMU
Wed, Feb 8, 2023 at 10:24 AM
To: James Ellis
Cc: Joe, Erich, Carla

Greetings JD!

So, guess what? This past month, I held a couple video sessions on making RSO 2.0 and the only person that showed up was Carla Kay! What would have been a flop turned into my education! :) First thing she asked is if I've run tests to verify my findings. The answer was yes, but in various bits and pieces, but not all put together into a coherent way. So for the past few weeks, I've been running some basic tests to evaluate whether RSO 2.0 is really cleaner than the original RSO. The answer is yes, this technique does result in cleaner oil. But really, the challenge was as easy as stepping over sidewalk cracks because ANYTHING is better than the original RSO!!! :D Most RSO is a straight alcohol wash, particulate filtering and then final reduction. This typically results in a ~33% potency. My current lab results show total cannabinoids at ~787%. I'm happy to report, the process does create cleaner oil. Whether its clean enough to dab will be the ultimate test. My main concern in these tests has been yield losses. The question asked is this process causing losses of cannabinoids? Up front, I have regularly see a 1/3rd loss in volume assuming 2ml of resins per ounce of plant material. So, to Carla's question, I ran 3 jar tests to test various effects on the volume.

The three tests summaries follow with full illustrations. First, a couple assumptions. These tests were run to measure the yielded volume of resins, not the potency. My potency tests were done on various batches over the past couple years. I'm going to assume the potency for these tests are in the same ballpark. My very first lab test of straight RSO showed 37% THC and ~40% Total Cannabinoids. I believe this is an accurate baseline for crappy RSO as others have said their tests have come in somewhere in the 30s. Over the past couple of years, I've run three additional potency tests and found my Total Cannabinoids improved to be above 77% and CBD at 66/67/69%, doubling the original RSO lab test. So from a potency standpoint, I'm hovering just below Distillate concentration. I use these #s as a ballpark since reaching 80% is a theoretical limit for what I'm doing in the kitchen. The last assumption is the standard ballpark estimated yield of 2ml per oz of plant material.

For each of these tests, I ran the first jar as a control, boiling it down immediately to get a full measurement of resins.

Conclusion:

Overall, this process reduces the volume of resins by 30-50%. These losses are a considerable amount of non-cannabinoid compounds. My 5 lab potency tests show a doubling of potency as the process developed into it's current form. So, from a high level view, this process successfully refines the lipids and removes some trash. But what I still don't know is what percentage of cannabinoids are lost in this process. Here's where losses occur -

1. Silting removes phospholipids (per cooking oil industry refinement processes) with the initial GC shows no cannabinoids. So very little or no losses here. The 'gunk' layer is whitish/greyish, ie, lacking chlorophyll. It's semi-polar straddling between the alcohol and water layers. So therefore I would assume some cannabinoids may be bonded to this mess. The salting out of the alcohol disrupts the hydrogen bonding causes certain molecular weights to settle out and this is the phospholipids

coagulating around the salt causing the Snow Globe effect. Silting only partitions lipids, does not separate out additional material as shown in test #1. This fractioning of lipids leaves a purer volume of non-polar resins to be further refined. Interesting to note - water degumming failed to generate any particulates so it was distilling that brough the initial reduction in these tests. 91% alcohol introduces enough water to interfere with degumming. A subsequent jar test afterwards showed additional salt to compensate for the additional water; therefore, started working again.

2. Distilling in water. The threat is an emulsion carrying away cannabinoids. Water alone will cause emulsions as it's miscable with alcohol. The use of brine salts-out the isopropyl so there's no emulsion when distillation is terminated at 195f. The water is typically a clear amber color. Ethanol does have an emulsion problem with either water or brine all the way up to 212f. The salt doesn't help here. This lends credence to using Isopropyl up front for the bulk extraction, then ethanol for the final reduction. I was saving this for the 2nd email, but needs some explanation now. 'Rapid Winterization' might be enabled by this mismatch of polarities in the solvents.

3. Rapid Winterization. This needs a deep dive. I am saving the full discussion for the 2nd email, but what I have found is using Isopropyl to do the bulk extraction is done at one polarity. After distillation, the water is dumped out, the oils dissolved in ethanol, a more polar solvent. This causes immediate visible crystallization of non-polar compounds. Given that Silting removed semi-polar compounds and Distilling removed the rest of the water soluble polar compounds, we have a refined base of lipids that nows are sensitive to polar water content. Dissolving in ethanol and then placing it in the freezer takes no longer than an hour to reach 0f. Pour the solution through a paper napkin and you catch a vast majority of the waxes and emulsions. If you let this napkin dry out, the gunk shrivels up proving it had some alcohol and water to enable emulsions. The longer the ethanol sits in the freezer, the darker the gunk becomes. This is chlorophyll bonding to the waxes via some form of lipids. The cannabinoids are bonding too, proved out by ingesting this wax and subsequent high. So, how much of the cannabinoids are lost? This needs lab testing, but I suspect the losses increase over time. Standard winterization between 12-48 hours also shows a darkening of waxes thus most likely the same phenomenon.

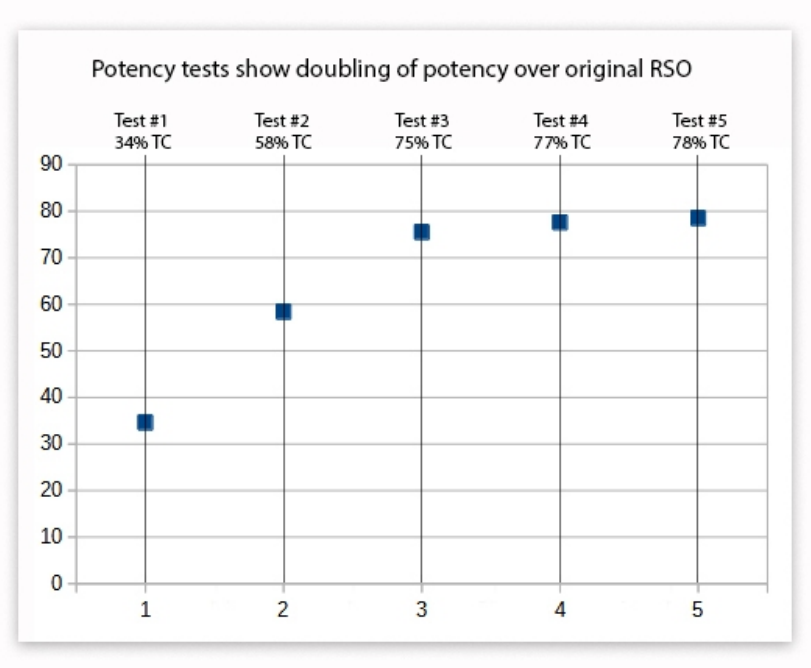
4. Transfer Losses. There can be losses when dumping out the distilled waste water and leaving oils behind in paper filters and on utensils.

So, thats it for this email. Sorry its a lot all at once. I think my science is good, but my optimizations still need help. Carla gave me several to work with and will elaborate more in the next email. Everything here is done at the amateur level, but should prove out in more rigorous lab testing. I kind of threw out a surprise find in this email by talking about Rapid Winterization. This was an unexpected find, but I believe the offset in polarities of the two solvents may be the mechanism. Its kind of the same effect of methanol and waxes separating out, but on a smaller scale. Erich, I will show you a fresh batch of waxy blobs/crystals floating in the ethanol.

Anyway, I know its a lot to swallow, but am I missing anything obvious?

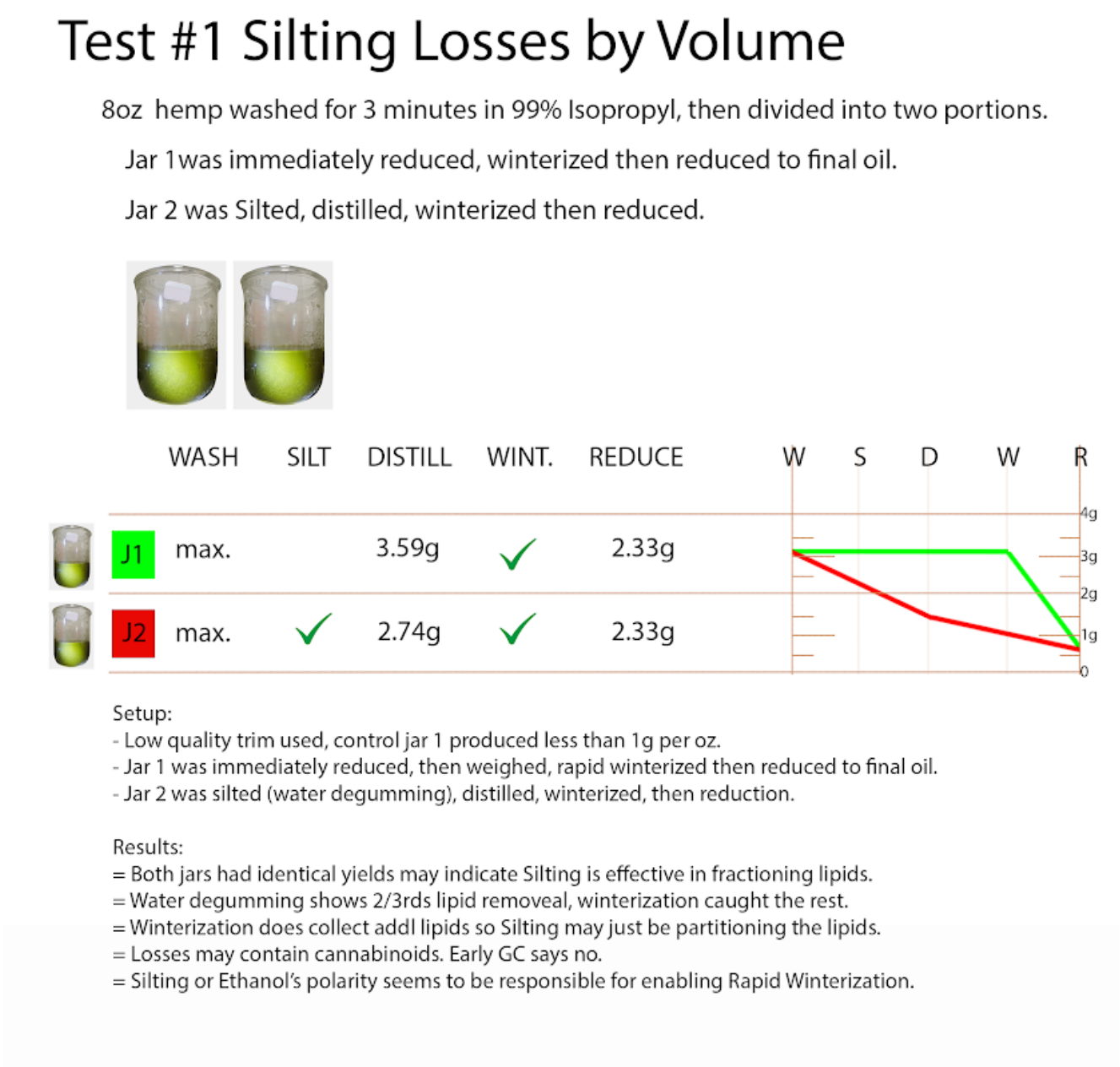
Doug

Summary of Potency Lab tests:



Link to 5 potency Lab results – Scroll down to find the reports.
https://www.cannabishomesciences.com/documentation/isopropyl-alcohol-controversy

Test1: Yield losses from Silting.



This test shows Silting and Distilling to have a 50% loss in volume by weight. I believe most of the reduction is due to water soluble stuff - polar as well as semi-polar content being removed. Over the course of the past 2 years, I normally would see a 30% reduction in volume. I believe the difference between 30% and 50% is a trim issue. The control case dropped to this yield after Rapid Winterization. Both jars had identical yields in the end, which would indicate the phospholipids are removed via standard winterization. So, my conclusion is that Silting actually partitions off the lipids by separating out the phospholipids. Silting just cuts the same pie into pieces. That's the big take-away in this test. Brine Isopropyl Degumming essentially breaks the lipids into fractions. It's not cleaning out anything more than what a full winterization would remove. But it may help with the upcoming 'Rapid winterization'. Rapid Winterization is discussed in the conclusions. This will be added to a follow-up email with all the things I've discovered since October and areas enlightened by Carla. This email is focused on testing for losses.

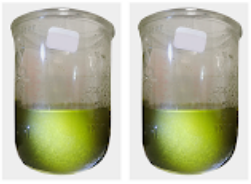
Test2: Can RSO 2.0 clean up long soaks?

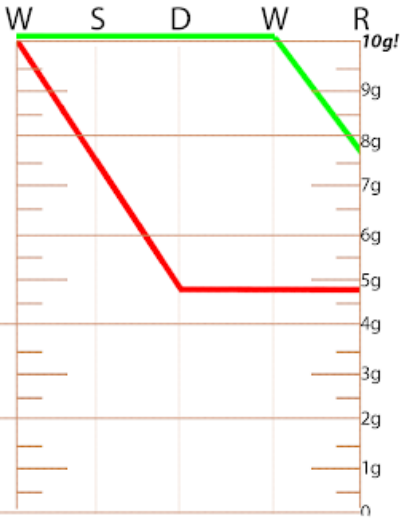
Test #2 Long Soak Volume

4oz hemp washed for 12 hours in 91% Isopropyl, then divided into two portions.

Jar 1 was immediately reduced, winterized then reduced to final oil.

Jar 2 was Silted, distilled, winterized then reduced.





	WASH	SILT	DISTILL	WINT.	REDUCE
J1	max.		**10.19g**	✓	7.94g
J2	max.	✓	N/A	✓	4.84g

Setup:
- Low quality trim used, control jar 1 produced an astonishing ~5 grams of resins per oz.
- Jar 1 was immediately reduced, then weighed, rapid winterized then reduced to final oil.
- Jar 2 was silted (water degumming), distilled, winterized, then reduced. Volume was only measured at the end. Distilling cleanup had minor transfer losses of about .25g-.5g.

Results:
= 91% ISO does not produce the Snow Globe effect or any particulate. No filtering done.
= Both jars had radically different yields suggests long soaks gradually dissolve unwanted compounds.
= Jar 1 Rapid winterization only removed 30% of the volume with final volume unusually high.
= Jar 2 Silting (water degumming) and a longer 4 hr winterization removed 50% of the volume.
= Rapid winterization resulted in a 20% drop in jar 1 leaving a lot of polar compounds.
= Silting or Ethanol's polarity seems to be responsible for enabling Rapid Winterization.

Author comment: Long soaks should be outlawed!!! OMG! What a mess.. This test does a 12 hour Long soak using 91% ISO for creating the Worst-Case scenario. First ramification - Initial volumes swelled up to over 5ml per oz! Lots of trash dissolved. Second ramification - Water Degumming fails. The control jar yielded 10g of bitter resins from 2oz of plant. That's over double what is expected. By Silting, distilling and winterizing, the yield was brought down to conventional values. Note: Water degumming failed to generate any particulates from this 12 hour watery soak and also in the following test. (A fix was found. Adding more salt to compensate for the 9% increase of water and now 91% Isopropyl works fine. 91% failed due to this additional water content.)

Test3: Is brine needed at all or will water do? Can the salt be abandoned and use just water?

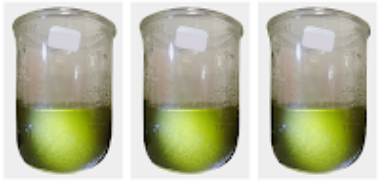
Test #3 Silting - Water & Acid Degumming

4oz hemp washed for 12 hours in 91% Isopropyl, then divided into three portions.

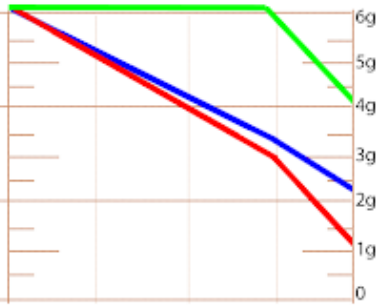
Jar 1 was immediately reduced, winterized then reduced to final oil.

Jar 2 was Silted, distilled, winterized then reduced.

Jar 3 was Silted, distilled, winterized then reduced.



	WASH	SILT	DISTILL	WINT.	REDUCE
J1	max.		**6.15g**	✓	4.09g
J2	max.	✓	3.02g In water	✓	1.27g*
J3	max.	✓	3.40g In brine	✓	2.30g



* bit of transfer loss when winterizing

Setup:
- Low quality trim soaked for 12 hours, control jar 1 produced a little over 6 grams.
- Jar 1 was immediately reduced, then weighed, rapid winterized then reduced to final oil.
- Jar 2 was Silted (acid degumming), distilled, winterized, then reduced.
- Jar 3 was silted (water degumming), distilled, winterized, then reduced.

Results:
= 91% ISO does not produce the Snow Globe effect or any particulate. No filtering done.
= Both jars 2 and 3 had similar yields shows Distilling in water/brine removes some content.
= Jar 2 removed 80% of the volume, jar 3 removed 60% of the volume but both are still within yield range for 1.3oz of plant material. Note: There was a minor yield loss in jar 2 during winterization.
= Silting or Ethanol's polarity seems to be responsible for enabling Rapid Winterization.

Fast answer, maybe. It would mean eliminating Silting and performing the Distilling in fresh water. I found Rapid Winterization still worked without Silting. But Jar 2 distilled in water vs brine had solubility issues. The oil formed tar balls and sank. Jar 3 distilled in brine had floating oil as anticipated. The salt fixes a solubility issue in water distilling. Using water in distilling removes water soluble content and deodorizes the oil, so distilling in water is very useful. The lab potency tests #1 and #2 show a major improvement between simple RSO and water distilled RSO. Using brine has historically resulted in favorable floating oils through the development of this process. It creates a safe zone of solubility where the oil stays floating due to the salinity. This needs a deep dive to fully

understand the solubility issues around salinity. But overall, both jars turned in very similar results after distilling. But the final reduction showed greater losses with the jar 2 most likely during Rapid Winterization. There was more darker 'gunk' removed than jar 3. Darker waxy gunk indicate more chlorophyll losses as well as other non-polar compounds. To be discussed..