Rad Source Technologies' 3 Year Study on the Efficacy of Photonic Decontamination of Cannabis

Introduction

With increasing legalization of medical and recreational-use cannabis in the U.S, there is a need for reliable analytical testing to ensure safe, pathogen-free consumption of cannabis.[1] According to the United Nations, more than 3.8% of the world's population, or 158.8 million people around the world use cannabis.[2] Therefore, it is extremely important that cannabis users are not being exposed to harmful microbial contaminants. This is especially important for medical use, as many of these patients tend to be immunocompromised and more susceptible to illnesses as a result of microbial contamination.[3]

Currently, as there are no national microbial requirements, the U.S. federal government has delegated authority to local and state regulatory bodies to implement and supervise strict quality regulations for cannabis harvesting and processing. Many labs are testing for the microbial load of aerobic bacteria, coliforms, yeast and mold, aspergillus, salmonella, and e. coli, including mycotoxins produced such as aflatoxin and ochratoxins. In order to ensure the safety of the product ultimately delivered to the consumer, growers utilize multiple cleaning and sanitizing processes in the everyday growth and cultivation of cannabis and in bringing non-compliant product into safe and useable cannabis.[2] Therefore, there is a need for a safe and effective decontamination system which Rad Source's 420 Cannabis Decontamination Systems fulfills.

The purpose of this white paper is to address the efficacy and safety of photonic decontamination utilizing x-ray, a safe and effective form of ionizing radiation in the treatment of cannabis and review 3 years worth of studies conducted by Rad Source's customers to support the efficacy of Rad Source's 420 Cannabis Decontamination Systems. The white paper goes through 5 studies conducted by customers in 5 different states across the U.S. and 1 independent testing lab.

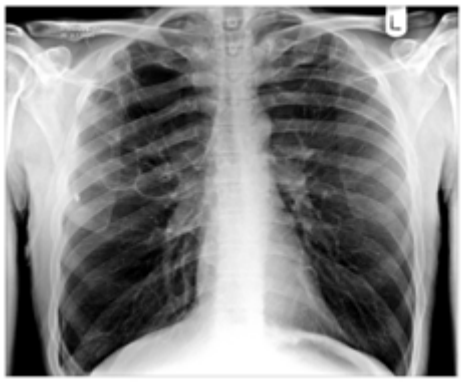


Figure 1. Bilateral apical bullae, more marked on the right; associated with a right pneumothorax.

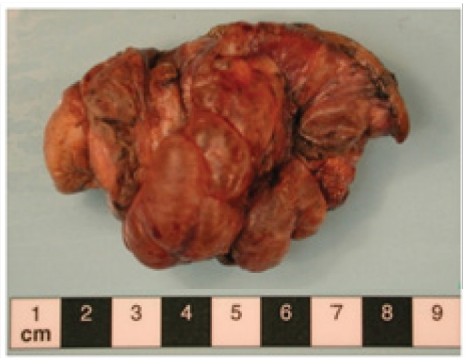


Figure 2. Fungal ball appearance found at sugery.

Public Health and Safety Concerns

As mentioned before, cannabis is subject to a wide range of potential contaminants including yeast, mold, insects, and other pathogens. Aspergillus is the most concerning in the cannabis industry. There have been documented cases of medicinal patients who have died from Aspergillosis, a condition caused by inhaling Aspergillus spores. Since there are multiple steps involved in harvesting, drying, processing, and packaging cannabis, decontamination processes are necessary to ensure safe consumption.[4]

One such case of chronic pulmonary aspergillosis is presented below. Figure 1 shows the lungs of a Caucasian male, age 47, with a right-sided pneumothorax, a collapsed lung who had a four-year history of progressive breathlessness. He was smoking marijuana to alleviate rheumatoid arthritis-associated joint pain. His symptoms included coughing up thick sputum and weight loss. His medications included a 5 mg daily dose of prednisolone and 1 g dose of sulfasalazine twice a day. His family history included one brother who had TB and another who had a pneumothorax. His pneumothorax did not resolve despite drainage; therefore, he underwent a right bullectomy (surgical procedure in which dilated air-spaces or bullae in the lungs are removed) and pleurectomy (surgery to remove lining of the lung).

Pleura are thin membranes that line the lungs and the inner chest cavity. One of the excised bullae (Figure 3) contained a pleural-based abscess containing an aspergilloma or a fungal ball (Figure 2).[4] Cases such as these prove that it's absolutely essential to ensure the customer receives a safe, compliant and useable product because the user's health is most important.

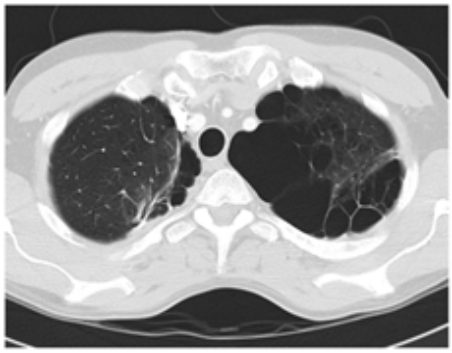


Figure 3. Postoperative CT thorax showing many large lung bullae in left apex with smaller bullae. The aspergilloma and surrounding cavity that was found was surgically removed.

Rad Source's 420 Cannabis Decontamination Systems

Rad Source's 420 Cannabis Decontamination Systems (shown in Table 1) that uses the patented Quastar® Photonic Decontamination technology provides the cannabis industry with the only technology to safely inactivate mold, powdery mildew, aspergillus, BTGN, yeast, salmonella, e. coli, coliform and other challenging microbes to prepare cannabis for testing and safe consumption. Our room temperature process maintains flower integrity w/ nominal to no effect on cannabinoids, terpenes and moisture levels, and allows our customers to pass state mandated testing levels with 99.9% confidence. Rad Source's 420 Cannabis Decontamination Systems offers unmatched, superior dose uniformity ratios (closer to 1), which ensure that a consistent microbial DNA inactivating dose is delivered throughout the cannabis flower.[5]

Gray (Gy) is a measure of ionizing radiation dose in the International System of Units (SI). A dose is the accumulated amount of Gy delivered to the cannabis material by the RS 420. The effective dose for a typical cannabis operation is 1600 Gy to 2000 Gy, with the dose determined by the bioburden of the facility itself. RAD Source works with the grower to determine the appropriate effective decontamination dose. This occurs initially with the grower and remains intact after that.

This technology is the only decontamination solution that penetrates the entire cannabis flower without destroying the flower or chemically modifying it. Rad Source offers 3 systems, 420M, 420Q and 420XL, shown in Table 1, that can be selected by the customer based on processing volume.[5]

Within the United States, the RS 420 line has been approved for use in the treatment of cannabis in multiple states. Some states do not require approval of this type of unit from an enforcement perspective. Rad Source also works with state agencies other than enforcement to comply with any regulations the state may have as it pertains to the equipment itself.

Photonic Decontamination Technology: The Science Behind Safety

The x-ray irradiator is a cabinet x-ray device that conforms to 21 CFR 1020.40 (cabinet self-contained x-ray devices) for optimal and safe use. The irradiator consists of a carousel system that rotates individual canisters around an x-ray emitter so that ionizing radiation is delivered to the cannabis placed within the canisters. Rad Source refers to this process as Photonic Decontamination, which is further explained below.

System	Power	Dose Uniformity Ratio	Processing Volume
420 M	4 kW	3 - 3.5	~1-2 lbs. / 3-4 hr. /cycle (based on product density & 2000 Gy dose)
420 Q	4 kW	1.8	Up to 5 lbs. / 4-5 hr. /cycle (based on product density & 2000 Gy dose)
420 XL	8 kW	1.6	Up to 50 lbs. / 7-8 hr. /cycle (based on product density & 2000 Gy dose)

Table 1. RS 420 Series Cannabis Decontamination System Types

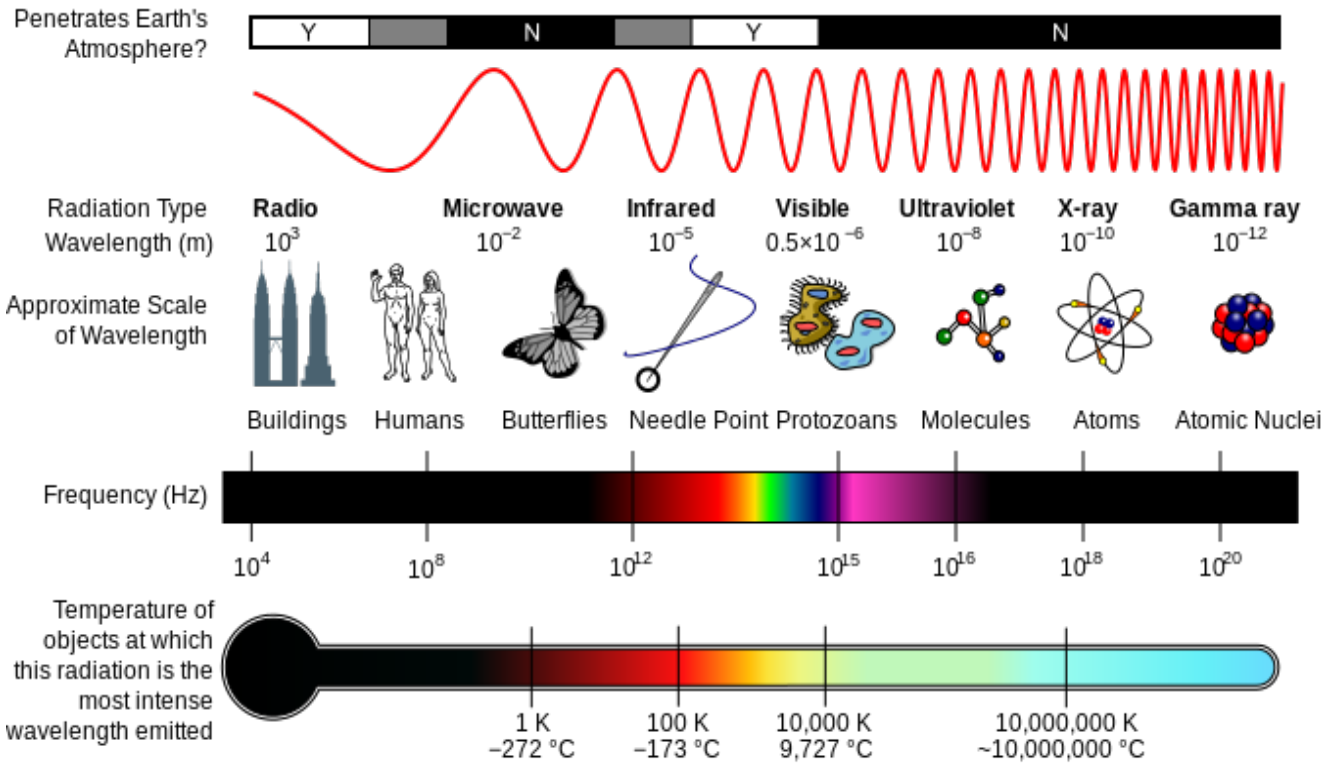


Figure 4. Electromagnetic Spectrum

How Photonic Decontamination Works

What is Ionizing Radiation?

Radiation is transmission of energy or particles through space and the particle stream has a defined wavelength.[6] Wavelength is important for penetration of a cannabis flower and can vary in size, which determines the depth of penetration through the product.The electromagnetic (EM) spectrum is the range of all types of EM radiation. As you go from left to right along the EM spectrum (Figure 4), the wavelength decreases and energy increases, meaning x-rays and gamma rays are able to penetrate product better than visible light or UV.[7] Ionizing radiation has enough energy to knock electrons out of atoms.

Ionizing radiation can come from natural x-rays emitted from processes that take place outside the nucleus, whereas gamma rays originate inside the nucleus.

When high energy electrons are accelerated towards a target material, it dislodges other electrons from their shells within the atom of the material. As the electrons from outer shells of the atom fall into inner shells, x-ray photons are generated. Gamma rays are produced through radioactive decay when the nucleus of an atom splits apart. This change emits a gamma ray since energy is conserved. Rad Source uses non-nuclear, x-ray wavelengths at a much lower energy level, similar to imaging x-ray tubes found in dentist offices and hospital imaging centers.[8]

How does Photonic Decontamination Treat Cannabis?

Photonic decontamination reduces or eliminates mold, related toxins and other pathogens in cannabis.[9] Ionizing radiation has enough energy to eject electrons from molecules, ionizing them, and often breaking the molecule apart. When a microbial DNA molecule is ionized, it is broken and therefore inactivated.[10] Microbes cannot grow or replicate with broken DNA.

Why is Photonic Decontamination the preferred method?

Although the mechanism of action is the same, the use of x-rays in treatment of cannabis is preferred over gamma rays because gamma rays use radioactive isotopes, which pose an environmental and security threat.

They leave harmful byproduct that requires specific methods for storage and disposal, and these irradiation sites require stringent licensing requirements, which is a burden on local jurisdictions.[11] There are programs in place designed to remove gamma sources and replace them with x-ray sources, which is the safer alternative.[12]

Other decontamination methods are not as ideal because they may either affect the chemical content (terpenes, cannabinoids), texture (moisture loss) of cannabis, or they may not penetrate the flower deep enough to eliminate all microbes within the product.[9]

Is Photonic Decontamination Safe?

Photonic decontamination is completely safe, widely-used and a highly-studied process that is used for a variety of applications including sterilization, blood transfusions, immunology and oncology research etc.[13] Ionizing radiation has been used for more than a decade in Canada and the Netherlands specifically for the treatment of marijuana. The RS 420 line has been either given permission or written "permission is not required" for use in the treatment of cannabis by marijuana regulators in multiple states.

Relevant to products treated for human consumption, food irradiation is endorsed by the FDA, the World Health Organization (WHO), the Centers for Disease Control and Prevention (CDC), and the U.S. Department of Agriculture (USDA). Specifically, food irradiation is beneficial for prevention of foodborne illness, preservation, control of insects, delay of sprouting and ripening, and sterilization that may be present in untreated food product.[14]

Rad Source History and Role in Safe Treatment of Cannabis

Rad Source was founded in 1997 in order to promote an effective and safe alternative to gamma irradiation. Even prior to recent security issues associated with radioactive gamma sources, Rad Source was dedicated to solving environmental disposal and related practical issues associated with "hot" source equipment (isotope-based). Rad Source introduced its first products in 1999 and has become the leading provider of renewable, non-isotope, ionizing radiation replacements for self-shielded gamma irradiators worldwide.[15]

Rad Source equipment is being used for various applications in close to all 50 states. It is recognized by the U.S. government as a safe alternative to gamma source irradiators. Over the last several years, Rad Source has replaced radioactive isotope-based irradiators throughout the U.S. and now is extending the program to other countries desiring replacement of gamma sources. Rad Source boasts an impressive and extensive client list including the American Red Cross, the Mayo Clinic, and the FDA – National Center for Toxicological Research.[16]

The RS 420 commonly utilizes a photon energy of less than or equal to 160 (keV). This is well below the 7.5 (MeV) maximum under the FDA's regulations for food irradiation. Thus, if cannabis was federally permissible and driven by food standards, the RS 420 would comply with the regulations that govern the irradiation of products for human consumption.

3-Year Review of Rad Source Customer Data and Insights

In order to ensure efficacy of Rad Source's 420 Cannabis Decontamination Systems, Rad Source has worked with customers and independent labs from various states to derive testing data on microbial reduction at varying treatment doses on several strains of microbes (yeast and mold, coliforms, BTGN, aerobic bacteria, salmonella, aspergillus, and e. coli). Natural compounds present in cannabis such as THC, CBD, CBN, CBG, terpenes, and moisture levels were also measured to evaluate effects of photonic decontamination on these compounds. Cannabis samples were also visually assessed to check for any signs of degradation.

Nevada Study: February 2017

This study was conducted to determine how varying levels of doses would impact pathogens present in a cannabis flower. Samples were tested to determine the microbial load of total yeast and mold (TYM), total viable aerobic bacteria (TVAB), bile-tolerant gram-negative bacteria (BTGN), and coliforms. Samples were treated at 1000, 2000 and 3000 Gy. Results showed that treatment at 2000 Gy was sufficient to pass state-mandated testing.[17] Microbial reductions ranged between 92% - 99%. Samples were tested for e. coli and salmonella as well, and none was found in pre-treated samples. Since the microbial load in sample 3 dropped below the limit of quantitation (LOQ), the microbial reduction percentages listed in Figure 5 are at least that, if not higher.

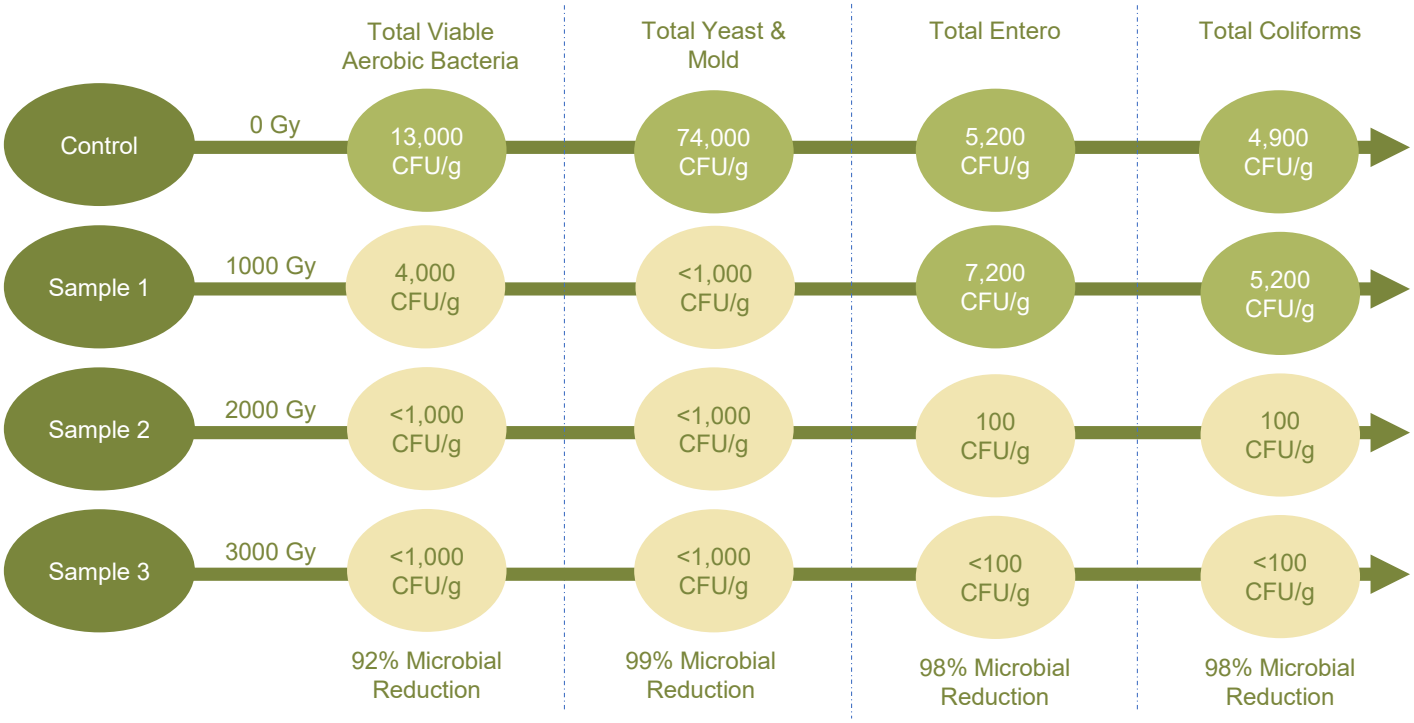


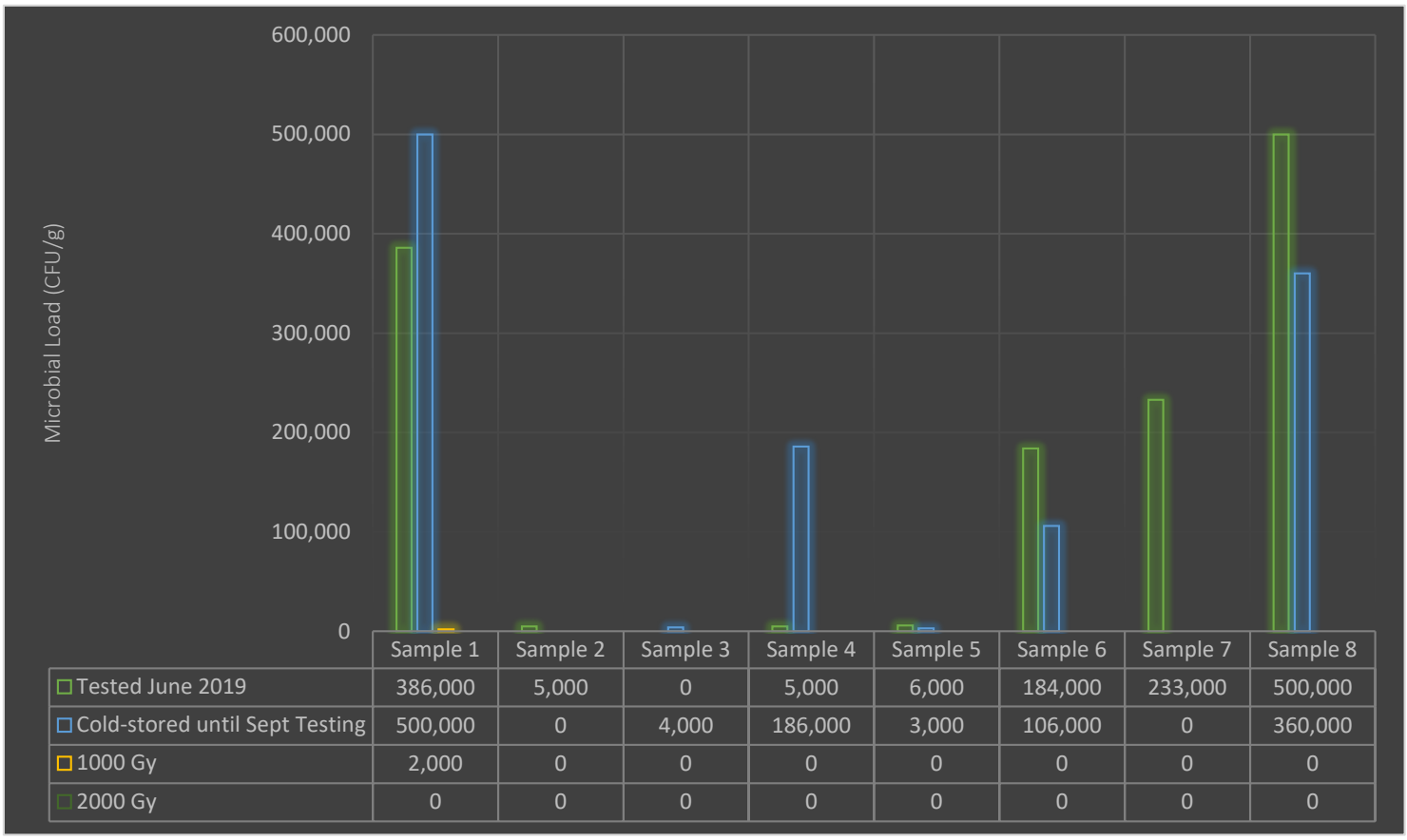
Figure 5. Microbial reduction across varying dose exposures. Note: Light green color signifies failure, light yellow signifies pass.

The data in figure 5 shows a higher microbial load in entero (BTGN) and coliforms after being subjected to 1000 Gy exposure treatment than that of the controls. This discrepancy can potentially be explained by the fact that different samples were selected from the same batch and subjected to different exposure treatments and samples within the same batch can have varying microbial levels as well. In other words, not the exact same sample was treated multiples times (1000 Gy, 2000 Gy) to derive the CFU/g. Another possibility is the fact that the control and sample 1 may have had a longer duration between testing each sample, and the batch may have had increased microbial levels before exposure at 1000 Gy. This will continue to be a recurring theme throughout this paper since customers selected samples and controls.

Nevada Independent Testing Lab Data and Findings: September 2019

This study was done to prove the importance of testing to avoid "secret shopper" risk. Regulated secret shoppers in the cannabis industry serve to conduct random and spontaneous testing at grower sites. This is in the interest of public safety given any microbial load still present in the flower will continue to grow unless it is brought to a non-viable level. Cannabis products sitting on shelves could risk possible recontamination and failing tests conducted by secret shoppers.[18] In figure 6, the controls were tested in June 2019 (bags of cannabis), and cold-stored until September 2019 to show that microbes could increase in number. If it was not cold-stored, which tends to hinder microbial growth, the microbial growth would be much more.

8 total samples of 6 different strains (1 extra sample from 2 of the strains) were run at 1000 Gy, then a small portion of sample from each bag was taken and tested to determine the microbial load (TYM). The same bags were placed back into the machine, subjected to another 1000 Gy (now total of 2000 Gy) and samples were taken out from the bags for TYM measurements. Results showed that 1000 Gy was sufficient to pass state-mandated testing.[17] All samples showed microbial reductions of >99% at 1000 Gy. 50% of samples had failed prior to treatment (controls) and 100% passed microbial testing post-treatment. The 6 samples used in the study represent different strains, different microbial loads and required different treatment exposures to inactivate pathogens present. The level of efficacy is strain-dependent as well.



	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
Tested June 2019	386,000	5,000	0	5,000	6,000	184,000	233,000	500,000
Cold-stored until Sept Testing	500,000	0	4,000	186,000	3,000	106,000	0	360,000
1000 Gy	2,000	0	0	0	0	0	0	0
2000 Gy	0	0	0	0	0	0	0	0

Figure 6. Treatment at 1000 and 2000 Gy (Total Yeast and Mold)

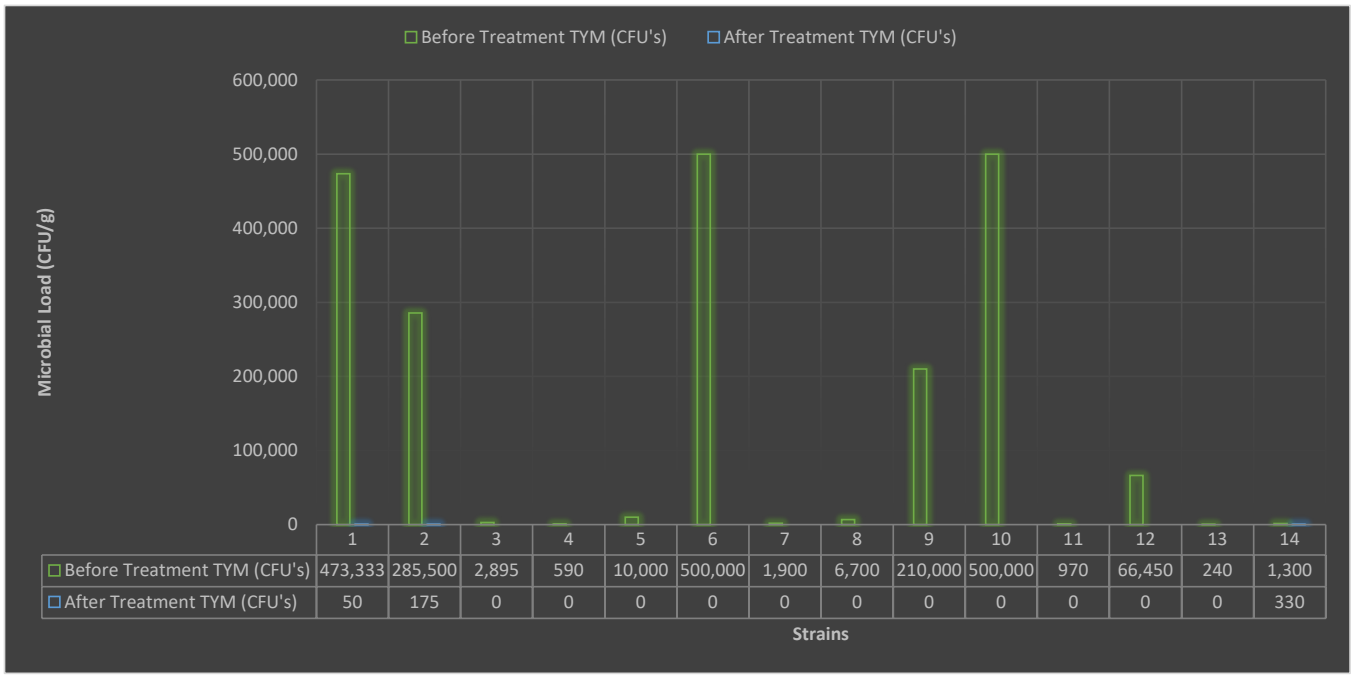
Looking at Figure 6, microbial load increases between June and September for some samples and decreases for others. Cold-storage is meant to hinder microbial growth (so there shouldn't be a significant difference between June and cold-stored September samples), but some samples still see an increase in microbial count. Microbial count should not decrease from cold-storage, however, samples 2, 5, 6, 7 and 8), show a discrepancy that may be explained by the fact that there weren't enough replicates for the test. Other errors associated with sampling and micro-testing include a wide range of differences among test results and microbial load in the same lot or bag of cannabis when 2 different samples from the same lot are tested (the sample that was taken out of the bag and tested in June, is NOT the same exact sample that was tested in September). As shown in this study, photonic decontamination gives customers the power to process their product in sealed bags, which minimizes the risk of recontamination.

There are no "open air" trays like those used in ozone, therefore, removing any potential risk for human or environmental contamination. Once inactivated in the bag, the product remains safe from recontamination on the way to its final destination – the vault, dispensary or testing lab.[19]

Colorado Study: October 2019

This study was conducted to evaluate the impact of photonic decontamination on multiple strains of cannabis, and determine whether 2000 Gy was sufficient to pass state-mandated testing for all strains.[17]

Multiple samples of 14 strains (shown in Table 2) were tested for microbial contamination before and after treatment. 50% of samples failed state microbial testing pre-treatment, and all passed post-treatment (as shown in Figure 7). For most strains, microbial levels were reduced to under <LOQ (which was > 99.99% microbial reduction). 2000 Gy demonstrated to be sufficient for all strains tested.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Before Treatment TYM (CFU's)	473,333	285,500	2,895	590	10,000	500,000	1,900	6,700	210,000	500,000	970	66,450	240	1,300
After Treatment TYM (CFU's)	50	175	0	0	0	0	0	0	0	0	0	0	0	330

Figure 7. Total Yeast and Mold before and after photonic decontamination

Strain	# of Samples
Strain 1	3
Strain 2	2
Strain 3	2
Strain 4	2
Strain 5	1
Strain 6	2
Strain 7	3
Strain 8	2
Strain 9	1
Strain 10	1
Strain 11	1
Strain 12	2
Strain 13	1
Strain 14	1
Total	24

Table 2. Experimental set up

Different strains presented different microbial loads and would potentially require different exposures accordingly. The level of efficacy is strain-dependent.

Note: In figure 7, samples 3 – 13 are shown as 0 but the microbial count is < LOQ.

Ohio Study: April 2020

This study was conducted to understand the impact of photonic decontamination on the chemical content, (terpenes and cannabinoids) and microbial reductions of a cannabis flower. Dry flower material that had previously failed microbial testing was used in this initial remediation study. 3 cannabis strains were tested for TYM, TVAB, BTGN, and coliforms before and after treatment. The % THC, % moisture and % terpenes were also measured to evaluate the effects of photonic decontamination on medicinal elements. Treatments were selected based off of previous trials at other facilities in the network, and samples were sent to a 3rd party testing lab for measurements. Table 3 shows the experimental set up used. Before treatment, 100% of samples from all three strains failed microbial testing as depicted in Figure 8. As samples were subjected to higher doses from 900 – 3000 Gy, this number dropped). Post-treatment, at 2200 Gy, all samples passed microbial testing.[17]

Figure 9 shows the exact microbial load for all 3 strains across different treatments. Results showed a reduction of 87.5%, 100% and 92.5% in TYM after just the first exposure treatment (900 Gy) for strains 1, 2 and 3 respectively; For TVAB, strains 1, 2, and 3 reached maximum reductions of 91.6%, 100% and 93.8% respectively; For BTGN, strains 1, 2 and 3 reached maximum reductions of 69.6%, 100% and 100% respectively; For coliforms, strains 1, 2, and 3 reached maximum reductions of 47.9%, 100% and 100% respectively.

Therefore, the microbial reductions appear to be strain-specific. The largest percent reductions in contamination for strain 1 samples were observed at 2000 Gy treatment exposure.

Experimental Setup			
	Strain 1	Strain 2	Strain 3
Control	5 samples	5 samples	4 samples
900 Gy	5 samples	5 samples	4 samples
1800 Gy	5 samples	5 samples	4 samples
2000 Gy	5 samples	5 samples	4 samples
2200 Gy		5 samples	4 samples
3000 Gy		5 samples	4 samples
Total	20 samples	30 samples	24 samples

Table 3. Experimental set up showing the number of strains and samples tested for each

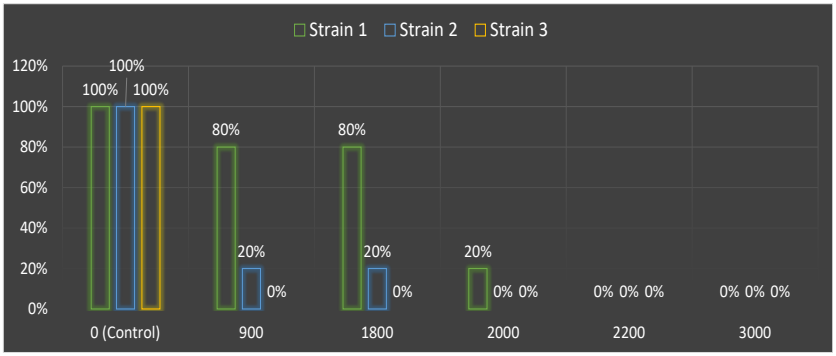
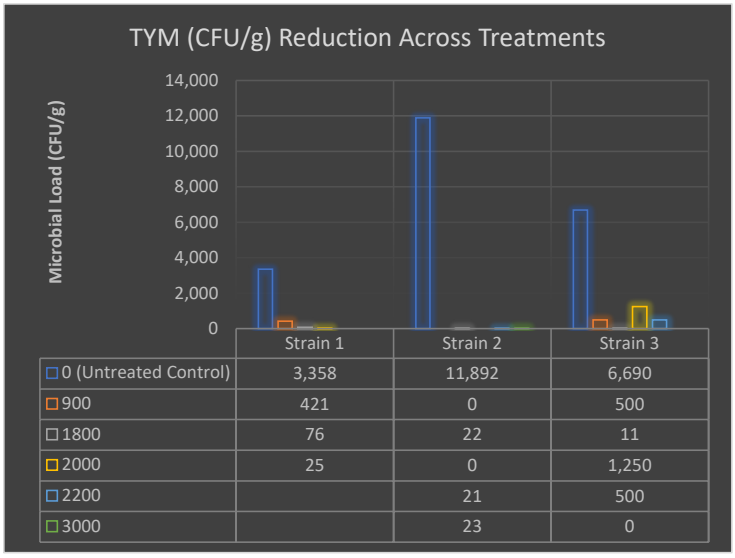
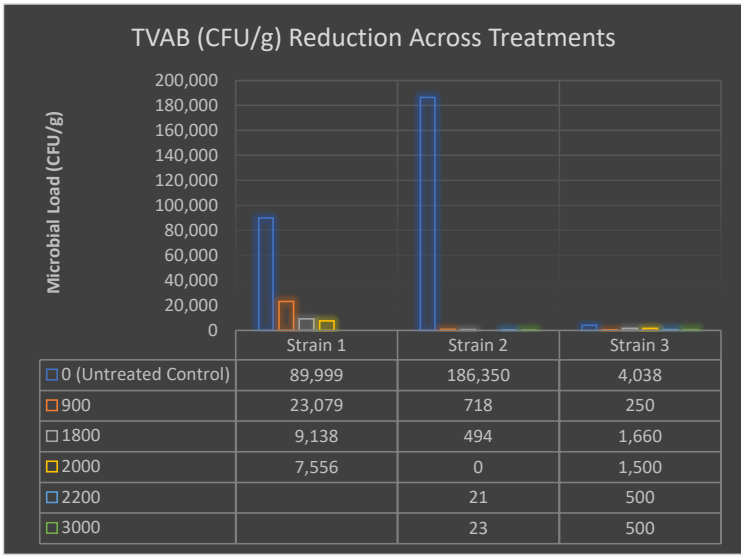


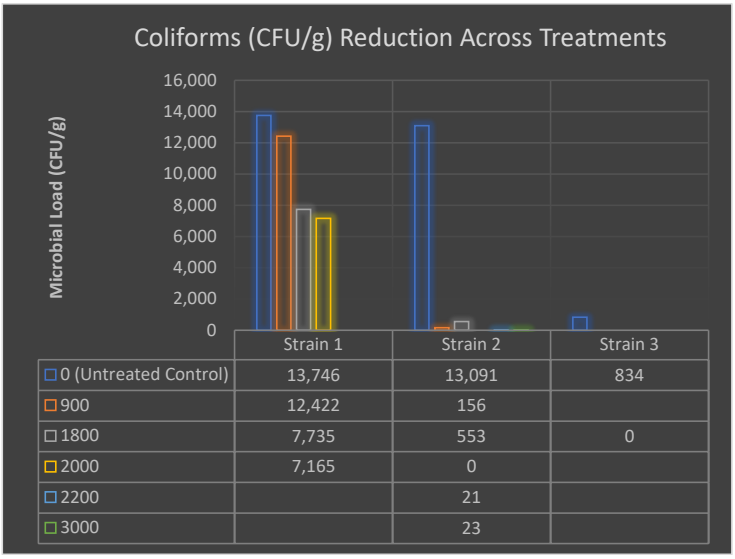
Figure 8. Strains that failed testing over a range of doses



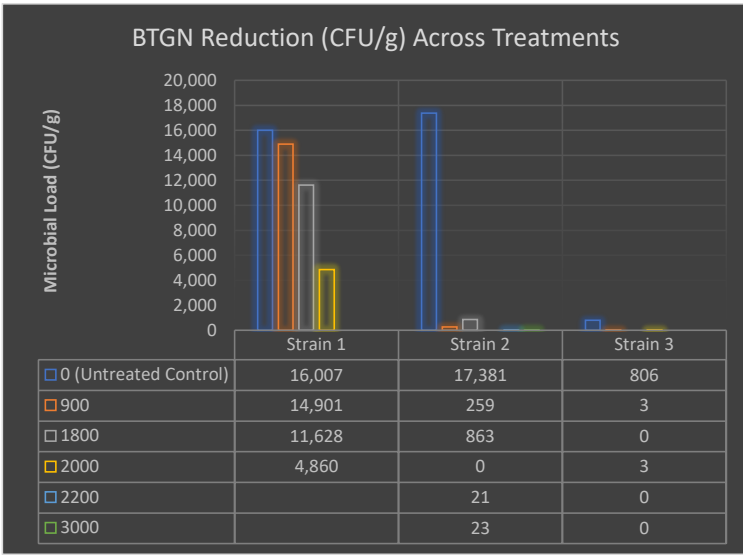
	Strain 1	Strain 2	Strain 3
0 (Untreated Control)	3,358	11,892	6,690
900	421	0	500
1800	76	22	11
2000	25	0	1,250
2200		21	500
3000		23	0



	Strain 1	Strain 2	Strain 3
0 (Untreated Control)	89,999	186,350	4,038
900	23,079	718	250
1800	9,138	494	1,660
2000	7,556	0	1,500
2200		21	500
3000		23	500

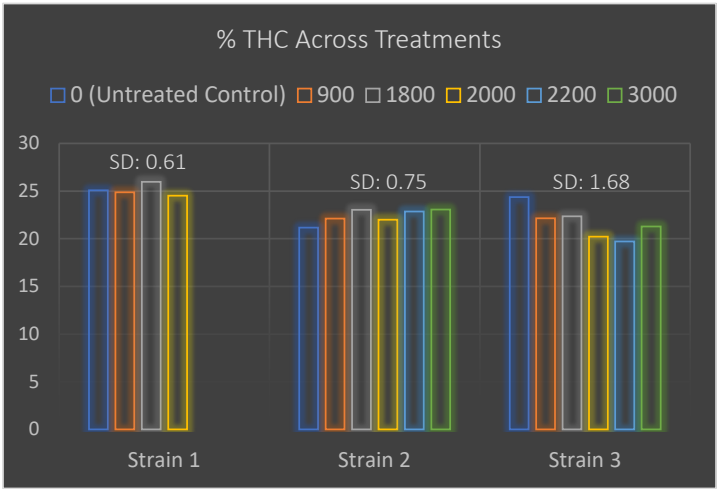


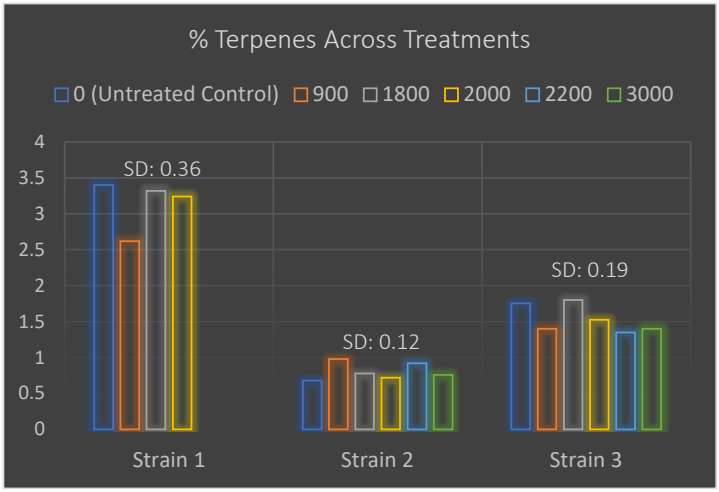
	Strain 1	Strain 2	Strain 3
0 (Untreated Control)	13,746	13,091	834
900	12,422	156	
1800	7,735	553	0
2000	7,165	0	
2200		21	
3000		23	



	Strain 1	Strain 2	Strain 3
0 (Untreated Control)	16,007	17,381	806
900	14,901	259	3
1800	11,628	863	0
2000	4,860	0	3
2200		21	0
3000		23	0

Figure 9. Microbial Reduction by Strain and Treatment Exposures





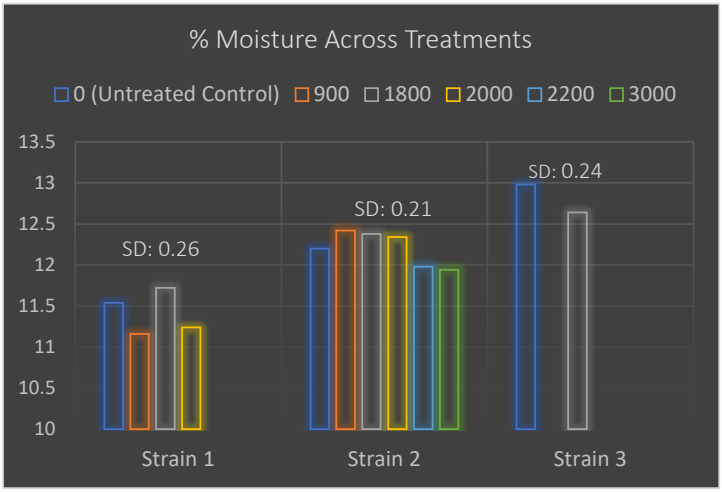


Figure 10. Cannabinoid and Terpene Profiles in pre-treated and post-treated samples

Reductions in percent contamination for strain 2 samples were consistently between 95% - 100% across all strains and treatment exposures.

Figure 10 shows the percent weights of THC, moisture and terpenes across treatment intervals of 900 – 3000 Gy for all three strains. None of these were significantly reduced across treatment exposures (Standard Deviation (SD) is provided on the charts as well). Variation exists due to moisture level variation that may have been affected by room temperature/conditions. Samples stayed within standard deviation.

Figure 11. Visual appearance of pre-treated and post-treated flower

Pictures of strain 2 (Figure 11) dry flower material were taken prior to treatment and after every treatment interval to visually assess and compare pre-treated and post-treated samples. There was no apparent visual degradation (bleaching, burning, moisture loss) of the strain 2 dry flower material when comparing treated material to control samples.

California Study: 2020

The California study took a close look at the inactivation of Aspergillus post-treatment of cannabis. The objective was to determine whether photonic decontamination could be a feasible method of remediating cannabis flower contaminated with any of the 4 species of Aspergillus (A. niger, terreus, flavus and fumigatus), and what methods would work best in measuring the presence of Aspergillus.

According to Figure 12, a contaminated cannabis flower was weighed and pre-treated with 2500 Gy to ensure that all Aspergillus was dead. According to the results, Aspergillus was not detected. These results suggest that x-ray treatment at 2500 Gy seemed sufficient to render Aspergillus spores non-viable. Samples from this flower were then spiked with known amounts of Aspergillus spores before treating the samples at 2000 Gy and 5000 Gy. Samples were tested at 2000 Gy, and qPCR was performed along with Potato Dextrose Agar (PDA) plating to detect Aspergillus levels. The same was done at 5000 Gy.

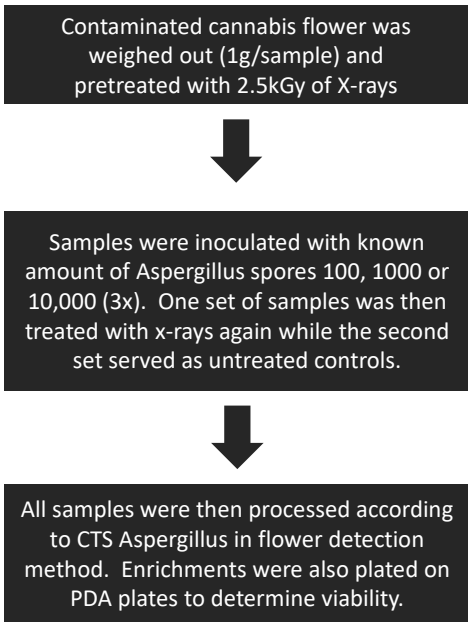


Figure 12. Experimental Design

Figure 13 below shows the results. At 2000 Gy, Aspergillus Niger and Terreus were not detected. At 5000 Gy, none of the Aspergillus strain types were detected. The spiked cannabis samples were not run at any dose levels between 2000 and 5000 Gy, to ensure what dose may have been required to treat a more homogenized (since it was spiked) sample of cannabis.

The scientists chose to do qPCR alongside PDA plating in order to show that qPCR alone may not be sufficient to detect Aspergillus and measure levels present. qPCR and PCR cannot differentiate between viable and non-viable fungi.[20] Since Rad Source's technology kills the Aspergillus by breaking up certain DNA strands but doesn't wash it off of the actual cannabis flower, it would be detected if it is at detectable levels and if the chosen DNA fragment to conduct qPCR was not broken up. PDA plating has to be used in order to identify viable Aspergillus.

Again, even in this study, since different samples from the same cannabis flower lot can vary in microbial load, different samples demonstrate different dose requirements for treatment. The naturally contaminated cannabis flower sample may not have had as high of a load as the spiked samples. Therefore, none was detected.

Aspergillus strain type	Cannabis flower weight (grams)	Initial treatment dosage (grays)	Aspergillus detection via qPCR of naturally contaminated Cannabis flower treated with 2500 grays of x-rays	Aspergillus viability/growth on PDA plates post enrichment (2500 grays)	Aspergillus detection via PCR of spiked Cannabis flower treated with 2000 grays of x-rays	Aspergillus viability/growth on PDA plates post enrichment (2000 grays)	Aspergillus detection via qPCR of spiked Cannabis flower treated with 5000 grays of x-rays	Aspergillus viability/growth on PDA plates post enrichment (5000 grays)
Aspergillus niger	1 g	2000, 2500 and 5000 grays	Not Detected	Not Detected	Detected	Not Detected	Detected	Not Detected
Aspergillus flavus	1 g	2000, 2500 and 5000 grays	Not Detected	Not Detected	Detected	Detected	Detected	Not Detected
Aspergillus terreus	1g	2000, 2500 and 5000 grays	Not Detected	Not Detected	Detected	Not detected	Detected	Not Detected
Aspergillus fumigatus	1 g	2000, 2500 and 5000 grays	Not Detected	Not Detected	Detected	Detected	Detected	Not Detected

Figure 13. Results of Aspergillus detection at 2000, 2500 and 5000 Gy for qPCR and PDA plating

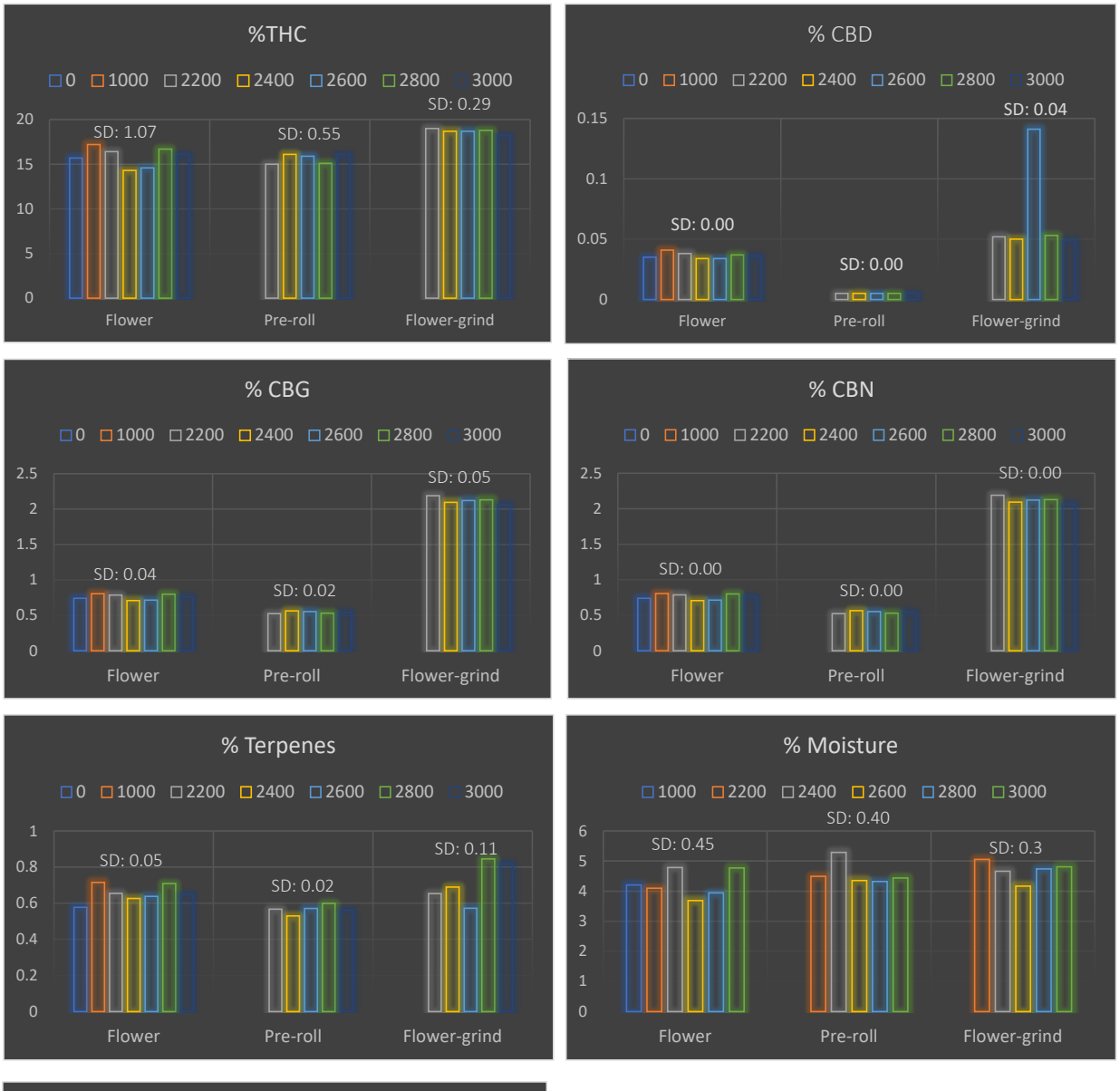


Figure 14. Cannabinoid and Terpene profiles in pre-treated and post-treated samples

Florida Study: March 2021

The Florida study served to depict the impact of photonic decontamination on different configurations of cannabis and the variation in dose levels that may be required to treat each configuration of cannabis. In addition, the impact of the treatment on cannabinoids and terpenes was studied as well. 3 configurations of cannabis (flower, grind and pre-roll) were tested for microbial contamination before and after treatment (0 – 3000Gy).

In addition, percent THC, CBD, CBG, and CBN, active cannabinoids, moisture and terpenes were measured to identify any variation in pre and post-processed samples. The control (non-treated sample) failed microbial testing. 1000 Gy was sufficient treatment to pass microbial testing for the flower configuration, and 2200 Gy was sufficient to pass microbial testing for the grind and pre-roll pack cannabis, proving that photonic decontamination technology is effective in treating cannabis independent of how densely or loosely packed the samples are.[17]

Figure 14 shows that none of these factors were significantly reduced across treatment exposures.

Rad Source's RS420 Series Decontamination Systems: Efficacy

According to Rad Source's 3-year study and the samples analyzed by various customers in various states, the data indicates a high level of efficacy in eliminating a wide range of pathogens without harming or impacting compounds that make up cannabis, and preserving potency, look, taste, smell and feel.

Depending on the strain and microbial load, studies demonstrated that treatments between 900 Gy – 2200 Gy proved effective in reducing microbe levels and helping customers pass state-mandated testing, and thereby providing safe product to the public. Microbial reduction averaged 96% overall in the studies conducted.

The discrepancy of 96% vs. the 99.99% confidence levels is due to these studies being purely experimental, and purposefully not using the necessary doses and times that Rad Source recommends to reach 99.99% confidence levels.

There was no significant reduction among cannabinoids, terpenes and moisture levels with average standard deviations of 0.83 (THC), 0.14 (terpenes), 0.31 (moisture), 0.01 (CBD), 0.04 (CBG) and 0.00 (CBN). The Ohio study also demonstrated that there was no apparent visual degradation (bleaching, burning, moisture loss) of treated flower material as compared to control samples. In addition, Rad Source's photonic decontamination technology can decontaminate different configurations of cannabis as depicted by the Florida study.

Customer Testimonials

"We have ran this machine through the gauntlet and it 100% percent performs as advertised!"
– Large Grower, Colorado

The Magic Bullet

"After working in the growing legal Cannabis market for over 5 years. I can attest that of all the treatment methods and services offered for microbial decontamination, this is the magic bullet" – Large Grower, Colorado

You Get What You Pay For

"No adverse effect on the terpene or cannabinoid profiles and guaranteed to remediate any yeast and mold growth you may be experiencing to non-detectable levels. You get what you pay for, and x-ray decontamination is the way to go."
– Large Grower, Colorado

Flower Integrity

"0% impact to product!
100% pass rate!"
– Medium Sized Grower, Michigan

Peace-of-Mind

"The Rad Source gives me Peace-of-Mind that no change in operating procedures or any other piece of technology has given me."
– Medium Sized Grower

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