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FUTURE IS CANNABIS OIL: AN EXTRACTION INDUSTRY OVERVIEW

Pure-play Extraction Investment Thesis

We believe there is ample biomass available in 2020E to support a budding Canadian extraction industry.

The combined annual biomass capacity of all publicly-listed extraction pure plays is ~1,405,000 kg (Figure 1).

- The Canadian biomass inventory published by [Statistics Canada](#) for the month of May 2019, was reported at 263,928 kg (finished and unfinished), a 22.3% MoM increase from April (Figure 18, Page 18).
- There is plenty of new greenhouse/indoor space coming online within the next year. For example, it is estimated that 9M sq. ft will come online in southern BC (Vancouver Island, Lower Mainland, Okanagan) and 21.8M sq. ft coming online in Canada with the next year 1-2 years (Source: [Financial Post](#)).
- Note that, in our opinion, none of these processors are close to reaching full capacity, so we can amplify this point.

Vertically-integrated licensed cultivators, notably, any over a market cap of \$1B, are not effectively equipped to support the high amount of biomass that is expected to come online in 2020E.

- [Colorado](#) and [Washington](#) in 2017 sold 115,249 and 17,976 kg, respectively, of extracts. Canada sold 66,786 kg from April 2018 to March 2019. Canada is only five years behind recreational legalization in these States.
- Many licensed cultivators are utilizing, or intend to use, CO2 to process its own biomass. This is not ideal for processing biomass at scale. Since no public company is using butane yet, and to our estimation, most companies do not utilize an ethanol system as well. The U.S. market has proved that CO2 is best for API purposes and higher-quality, expensive products, and that the majority of processing for scale is utilized by butane or ethanol.

Sales of dried flower are slowing

- Flower sales have slowed to an average growth rate of 8.0% over the last five months since legalization (Oct 17) while oil sales have grown at an average of more than 13.4% over the past five months.
- Retail stores have begun to operate but, in our opinion, are not even close to servicing the whole provincial markets.
- In general, the preference for consumers continues to be black-market dispensaries. We believe this supports the investment thesis for extraction companies, as the shelf life and quality of smoke/edible products are far easier than flower to standardize. As edibles reach the mainstream recreational market by year-end, we believe consumer behaviour will change.

Figure 1: Canadian Pure-play Extraction Production

Ticker	Company Name	Consolidated sq. ft.*	Funded Biomass Capacity (kg/yr)	Extraction Type				
				Ethanol	Butane	Propane	CO2	Other
CSE:VGW	Valens Groworks Corp**	400,000	425,000	Yes	Yes	Yes	Yes	Yes
TSXV:RTI	Radiant Technologies Inc	23,000	280,000	No	No	No	No	Yes
CSE:OILS	Nextleaf Solutions	6,540	250,000	Yes	No	No	No	No
TSXV:LABS	MediPharm Labs Corp	70,000	250,000	No	No	No	Yes	No
TSX:NEPT	Neptune Wellness Solutions	NA	200,000	Yes	No	No	Yes	No
Total:			1,405,000					

*Consolidated sq. ft. & annual biomass capacities are by company estimates only. Some of these companies do not provide how much of the space is currently operating/funded
 **Valens is expected to increase extraction capacity to 1,000,000 kg by H2/20

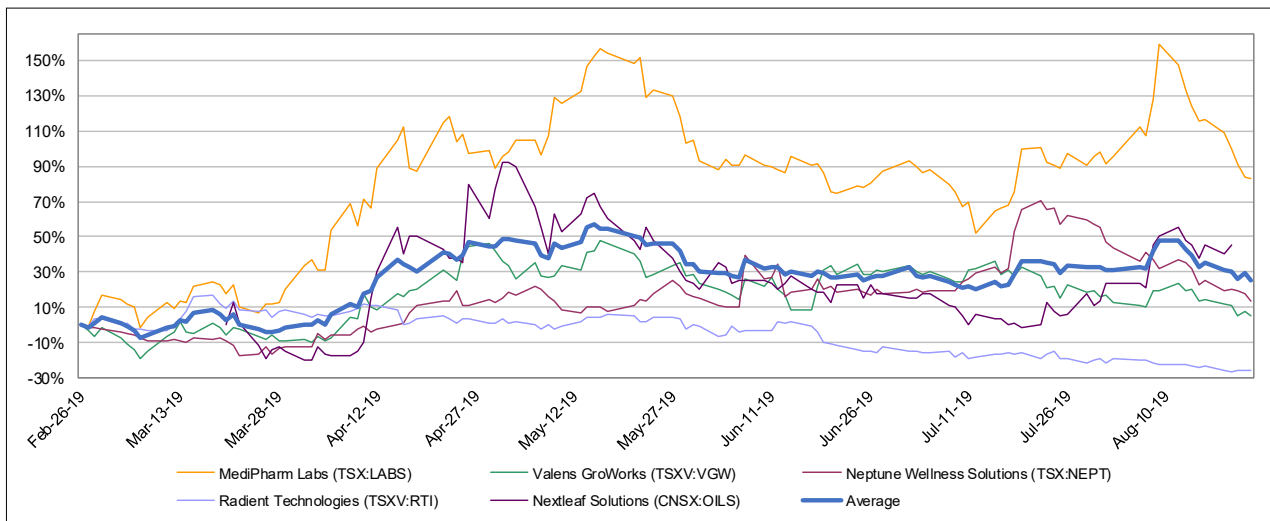
Source: Ubika, Company Reports

Six-Month Historical Share Price Movement in the Cannabis Sector (Pure-Play vs Extraction)

MediPharm Labs Q4/18 results set-off a shift in the Canadian cannabis stocks from cultivators to pure-play extractors. On April 2, 2019, MediPharm Labs (TSXV:LABS) reported Q4 results and its first material revenues. Revenue, gross margin, and EBITDA were \$10.2M, \$4.0M, and adj. EBITDA \$4.2M, respectively. We believe these financial results were significant for the cannabis market in Canada, as MediPharm was the first company to receive an oil license without being a cultivator. MediPharm ramped up quickly and surpassed many cultivators in terms of reported revenue and profitability. MediPharm reported Q2/19 revenue of \$31.5M on August 12, 2019, and is currently the third-highest revenue generating Canadian cannabis company behind Aurora Cannabis and Canopy Growth.

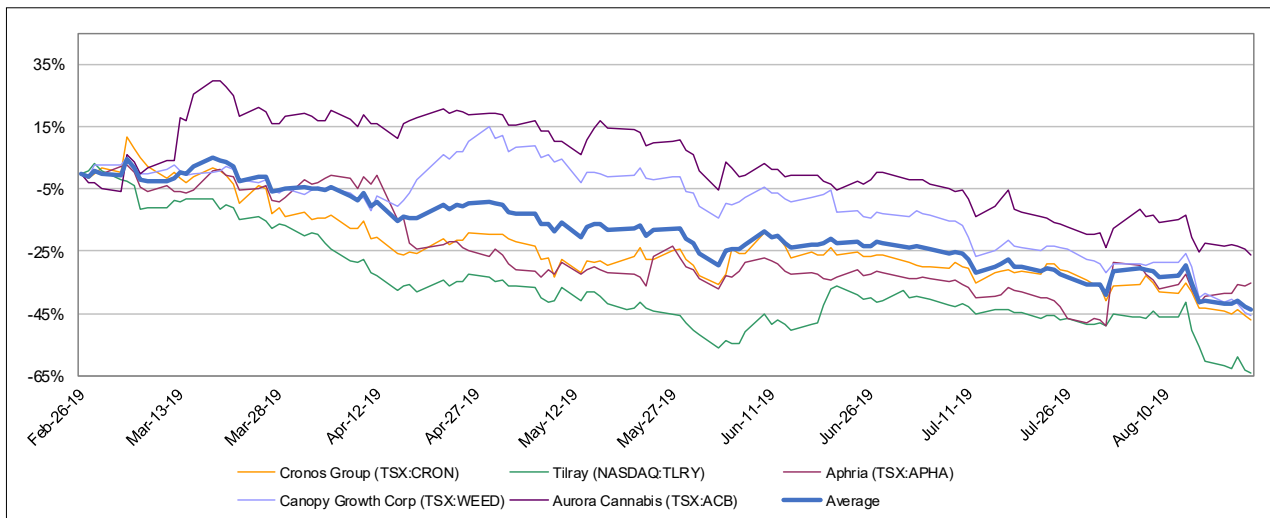
Extractors are outperforming the Top 5 Canadian cannabis companies over the past six months. Interest in companies with pure-play exposures to extraction has been heating up this year. Over the last six months, extractors have outperformed the Top 5 Canadian cultivators by 69% (+35% vs. -44%). To further illustrate the stark difference in execution, over the same time period MediPharm, the top extraction performer, has outperformed Canopy by 128% (+83% vs -45%).

Figure 2: Canadian Pure-play Extraction Six-Month Share Price Performance



Source: Capital IQ, Ubika

Figure 3: Canadian Cultivators Six-Month Share Price Performance



Source: Capital IQ, Ubika

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PLAYERS IN THE EXTRACTION GAME

Pure-play Canadian companies are still not taken seriously by the market. We believe as extraction companies continue to succeed and follow MediPharm's lead (one of the fastest companies to reach \$10M in revenue post-listing), the valuation gap between pure-play extraction companies and traditional Canadian licensed producers will close. On August 12, MediPharm Labs reported its Q2/19 results. These results featured revenue of \$31.5M, a 43% increase from Q1/19 and beating analyst estimates of \$27.1M. Notable, the Company also posted adjusted EBITDA of \$7.7M, a 79% increase from Q1/19 and beating analyst estimates of \$6.2M.

Figure 4: Cannabis Comps Table

Company Name	Last Price (\$CAD)	Mrkt Cap (\$CAD)	EV (\$CAD)	Cash (\$CAD)	Debt (\$CAD)	EV/Revenues			EV/EBITDA		
						2019E	2020E	2021E	2019E	2020E	2021E
Pure Play Cannabis Extraction Companies											
MediPharm Labs Corp.	\$5.00	\$662.6	\$595.7	\$72.9	\$6.0	4.1x	2.4x	1.5x	16.1x	7.5x	4.3x
Neptune WellNess Solutions Inc.	\$5.46	\$510.4	\$510.9	\$5.4	\$5.8	20.9x	7.8x	2.8x	n/m	33.3x	8.1x
Valens GroWorks Corp.	\$3.25	\$411.5	\$346.0	\$65.5	\$0.0	6.9x	2.1x	1.6x	20.7x	4.7x	3.4x
Radiant Technologies Inc.	\$0.71	\$189.8	\$164.7	\$31.8	\$6.7	n/a	n/a	n/a	n/m	n/m	n/m
Nextleaf Solutions	\$0.59	\$63.6	\$60.0	\$3.6	\$0.0	n/a	1.2x	0.5x	n/m	7.8x	1.1x
Mean Cannabis Extraction						10.6x	4.1x	1.9x	18.4x	15.2x	5.3x
Canadian Majors											
Canopy Growth Corporation	\$33.05	\$11,531.7	\$10,551.5	\$3,176.7	\$2,196.4	46.6x	16.9x	8.8x	n/m	n/m	n/m
Aurora Cannabis Inc.	\$7.46	\$7,670.8	\$7,774.7	\$535.2	\$639.1	30.7x	11.3x	6.5x	n/m	95.1x	23.9x
Cronos Group Inc.	\$15.05	\$5,079.2	\$2,758.6	\$2,324.2	\$3.5	n/a	12.6x	6.6x	n/m	53.9x	35.5x
Tilray, Inc.	\$37.71	\$3,674.5	\$3,919.1	\$324.1	\$568.6	16.1x	8.6x	5.1x	n/m	n/m	42.0x
Aphria Inc.	\$8.39	\$2,209.5	\$2,127.1	\$571.0	\$488.6	9.0x	3.2x	2.3x	n/m	28.3x	12.3x
HEXO Corp.	\$5.29	\$1,371.8	\$1,232.0	\$173.6	\$33.7	20.6x	3.6x	2.3x	n/m	20.7x	8.5x
OrganiGram Holdings Inc.	\$6.01	\$971.4	\$933.2	\$87.8	\$49.5	9.5x	4.5x	3.1x	25.2x	11.9x	8.3x
The Green Organic Dutchman Holdings Ltd.	\$3.15	\$867.7	\$801.3	\$68.7	\$2.4	20.0x	3.1x	1.6x	n/m	8.4x	7.5x
Village Farms International, Inc.	\$14.26	\$717.0	\$758.3	\$15.3	\$56.7	2.7x	2.1x	1.5x	17.3x	7.1x	4.3x
CannTrust Holdings Inc.	\$2.41	\$350.9	\$323.7	\$42.7	\$15.6	2.8x	1.6x	0.9x	n/m	7.0x	6.6x
Mean Canadian Majors						17.6x	6.7x	3.9x	21.2x	29.0x	16.5x
US Based Operations											
Curaleaf Holdings, Inc.	\$8.31	\$4,056.6	\$3,996.6	\$230.7	\$170.7	10.0x	3.7x	n/a	44.0x	11.4x	n/m
Charlotte's Web Holdings, Inc.	\$23.00	\$2,327.5	\$2,271.5	\$67.3	\$11.3	13.6x	5.6x	3.8x	54.2x	17.7x	10.9x
Green Thumb Industries Inc.	\$10.50	\$2,283.8	\$2,167.5	\$156.5	\$40.1	7.9x	3.5x	2.3x	39.3x	10.9x	7.7x
MedMen Enterprises Inc.	\$2.68	\$1,414.2	\$1,635.9	\$44.3	\$266.0	8.2x	3.4x	1.9x	n/m	12.0x	6.2x
Cresco Labs Inc.	\$10.78	\$1,379.5	\$1,366.4	\$80.0	\$66.9	5.7x	1.5x	1.0x	50.4x	5.6x	3.1x
Trulieve Cannabis Corp.	\$10.62	\$1,189.2	\$1,277.0	\$70.7	\$158.5	4.0x	2.5x	2.0x	9.1x	6.4x	4.9x
Acreage Holdings, Inc.	\$11.91	\$1,072.3	\$917.7	\$181.8	\$27.2	3.9x	1.7x	0.8x	n/m	5.4x	2.5x
iAnthus Capital Holdings, Inc.	\$3.18	\$575.0	\$672.4	\$56.6	\$154.0	3.7x	1.6x	1.4x	n/m	5.8x	4.3x
Origin House	\$6.78	\$504.9	\$482.4	\$39.3	\$16.7	3.2x	1.7x	1.3x	34.5x	8.6x	6.5x
Mean US Based Operations						6.7x	2.8x	1.8x	38.6x	9.3x	5.7x

Source: Ubika, Capital IQ

THE MARKET FOR CANNABIS OIL

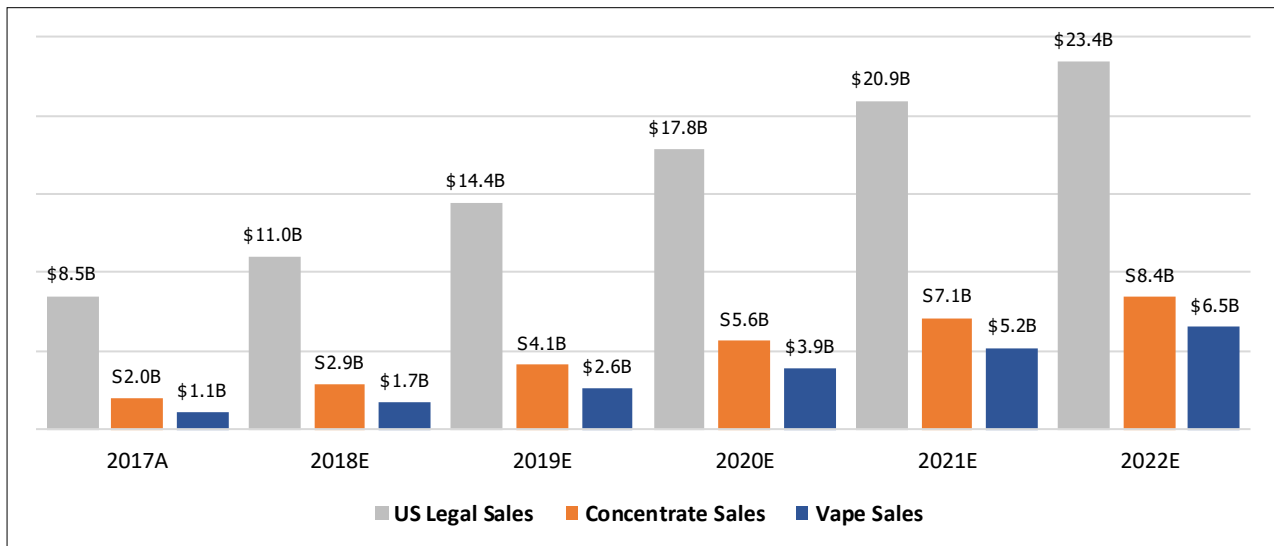
Legalization 2.0, or the legalization of cannabis edibles and concentrates, is expected to occur on October 17, 2019. According to [Ernst and Young's](#) Defining the Cannabis Sector in Canada by 2025E, released on March 26, 2019, the size of the legal market in Canada is estimated to grow from \$6.5B in 2019E to \$11B in 2025. EY estimates that 54% should likely be concentrates (extracts, edibles, and derivatives), and by extrapolating we can estimate a market value for concentrates of ~\$6B by 2025.

According to data from BDS Analytics, the concentrates and vape markets have potential to reach revenues of US\$14.9B in North America by 2022. We believe that this is due primarily to:

- 1) For medical purposes, doctors are unlikely to prescribe dried flower, due to the known dangers of smoking. Instead, doctors will likely prefer to prescribe capsules with a standardized dosage and consistency.
- 2) We believe products that more closely resemble the way alcohol or nutritional supplements are consumed, such as a bottle, bar, or power format, may help customers feel more comfortable towards adopting these new products.
- 3) Once products with a standard potency and consistency (edibles and capsules) enter the market, we believe consumers will prefer them, as they can more accurately monitor their intake when compared with smoking. Additionally, in the tobacco industry there has been a fairly steady decrease in smoking trends over the past five decades (University of Waterloo, 2017). People have been moving away from smoking for reasons such as stigma and health concerns. Assuming the cannabis industry experiences similar trends, edibles and capsules will be able to capture a wider range of customers who are against smoking.
- 4) For those who do smoke, we think they will prefer vape products, as there is already some evidence in the tobacco industry that suggests consumers are moving towards vaping as a healthier alternative to replace smoking cigarettes.

Research from the [UK](#) suggests that tobacco smokers who switch to vaping are less likely to smoke cigarettes again. Additionally, [Public Health England](#) (PHS), the country's health agency, has encouraged smokers to switch to vape products, as studies have shown that vaping has less harmful cancer-causing chemicals and tars.

Figure 5: US Cannabis, Concentrates and Vape Sales 2017-2022

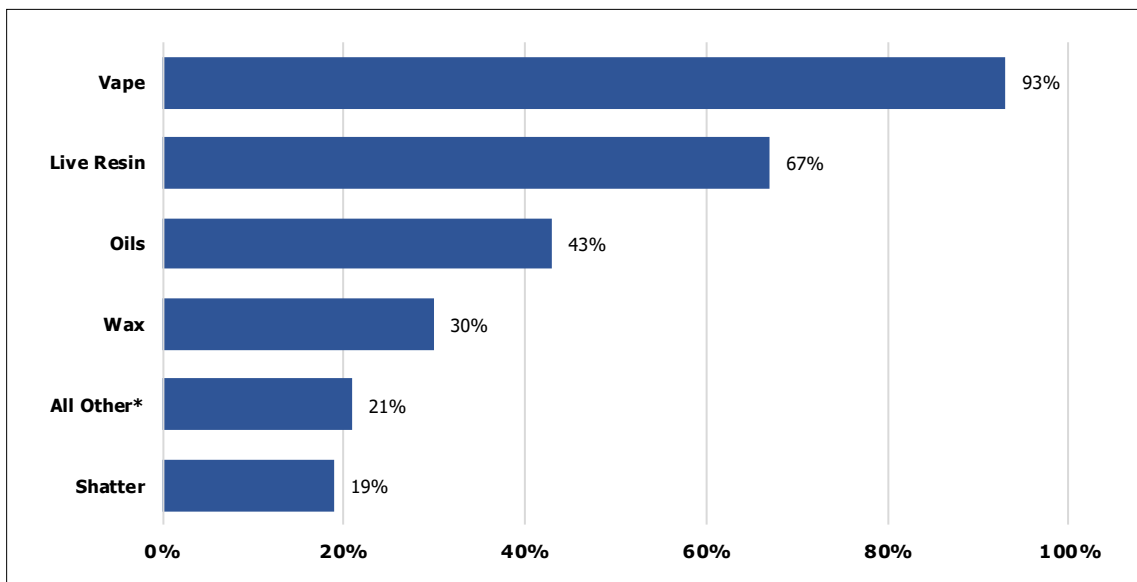


Source: BDS Analytics — Concentrates: The Hottest Product Category in Cannabis

THE MARKET FOR CANNABIS OIL

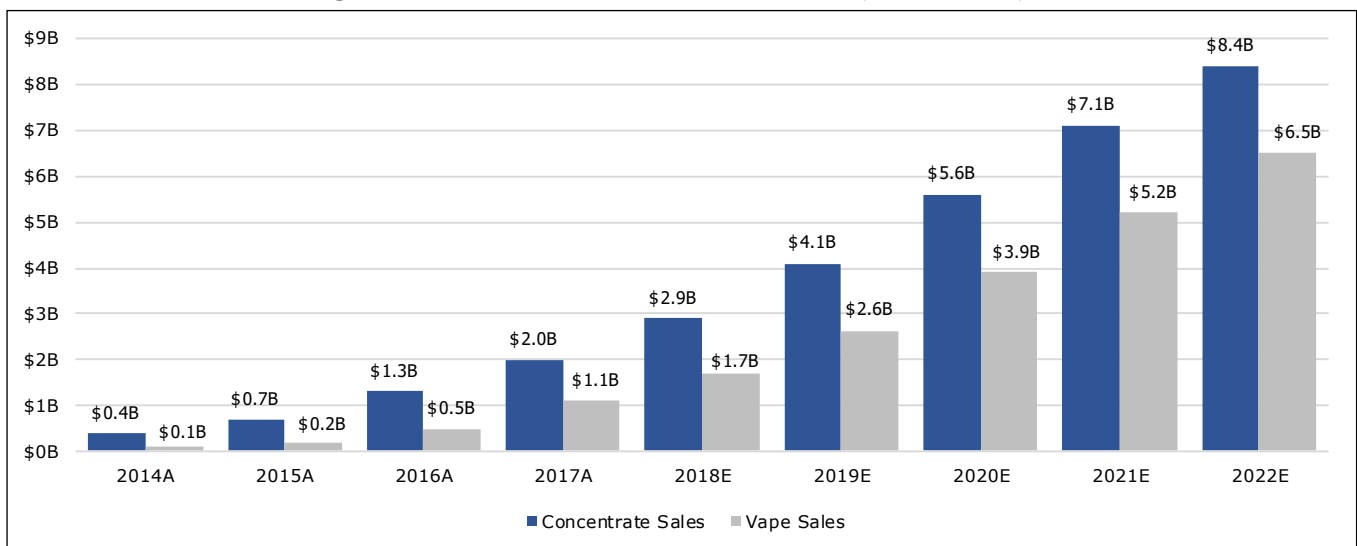
The 43% compound annual growth (CAGR) experienced by both of these categories is being driven by consumer preferences for concentrates and vapes over dried flower. Consumer preferences are moving towards concentrate and vape products mainly for three reasons: 1) stronger potency and duration; 2) more controlled dosage; 3) discreetness and safety. Moreover, concentrates have up to 95% THC/CBD content and can last up to 8-12 hours, which is suitable for many applications including: chronic pain, sleep disorders, anxiety/depression, and eating disorders. While there is a shorter duration with vape products (typically <4 hours), both products have a controlled dosage where the amount of MG being consumed is directly on the package. Concentrates, such as edibles and capsules along with vape, also pose less health risks than smoke and are more discreet with minimal odor and no taste compared with smoking. However, the PHS does admit that those who switched to vaping do not necessarily quit using nicotine products entirely. In our view, this trend should continue with smoking cannabis, driving vape sales.

Figure 6: 2017 vs. 2016 Growth by Product Subcategory



Source: BDS Analytics — Concentrates: The Hottest Product Category in Cannabis

Figure 7: U.S. Concentrate Sales 2014-2022 (\$US Billions)

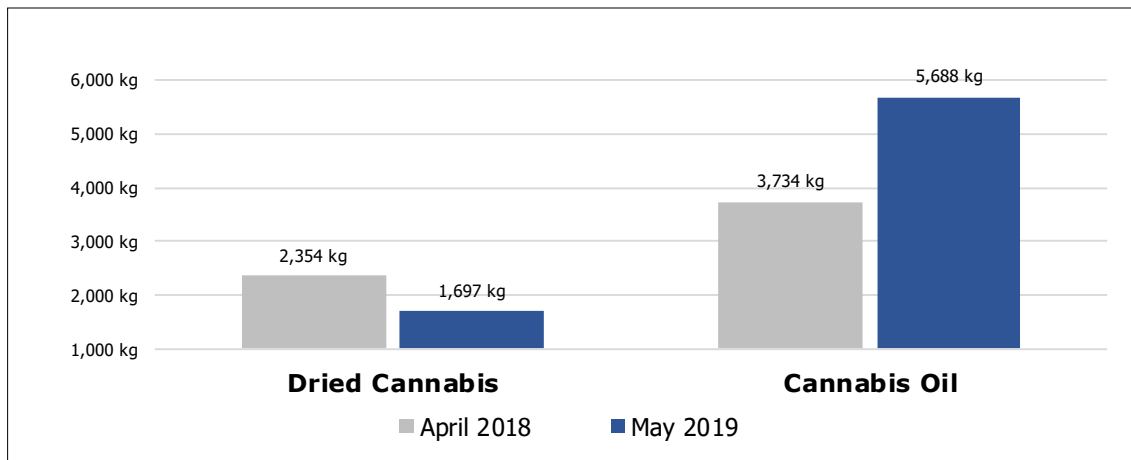


Source: BDS Analytics — Concentrates: The Hottest Product Category in Cannabis

THE MARKET FOR CANNABIS OIL

Distillate vape pens are the future. We believe concentrate sales in Canada will increase to more than 25% of the total market share of cannabis products within three years. We are basing this assumption on data from two mature legal cannabis markets in the U.S.: Colorado and Washington state, which legalized recreational marijuana in November 2012 and January 2014, respectively. In Colorado, a report prepared by the Leeds School of Business at the University of Colorado showed that non-flower products went from 26% of total sales in 2015 to 38% of total sales in 2017. Additionally, data from the Washington Liquor and Cannabis Boards shows that ~18,000 kg of extracts were produced in 2017, a 353% increase from 5,100 kg in 2015. Additionally, we highlight that data collected by BDS Analytics through point of sale terminals (Figure 6) has indicated that growth in wax, oils, resin, and vape products has grown 30%, 43%, 67%, and 93%, respectively.

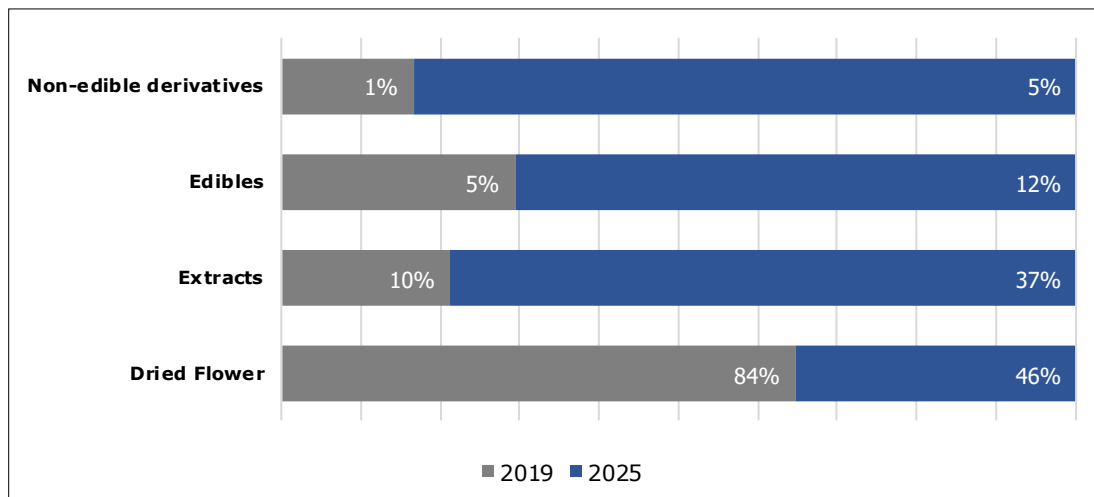
Figure 8: Canadian Medical Cannabis Sales Data



Source: Statistics Canada, Ubika

In Canada, we already have a decent sample size based on medical sales data provided by Health Canada. Medical cannabis oil sales grew 52% to 5,688 kg in May 2019, from 3,734 kg in April 2018. In comparison, medical dried cannabis sales were down 28% to 1,697 kg in May 2019, from 2,354 kg in April 2018 (Figure 8). In our opinion, once value-added cannabis products are legalized for the Canadian medical and recreational markets (estimated to be legal by October 17, 2019, the federal government’s target date for legalizing these types of products), the growth of derivative cannabis product sales should follow a similar trajectory in the recreational market, as seen in the medical market, and increase significantly over the next three-year period.

Figure 9: Consumption by Derivative Type



Source: EY – Defining the cannabis sector in Canada by 2025

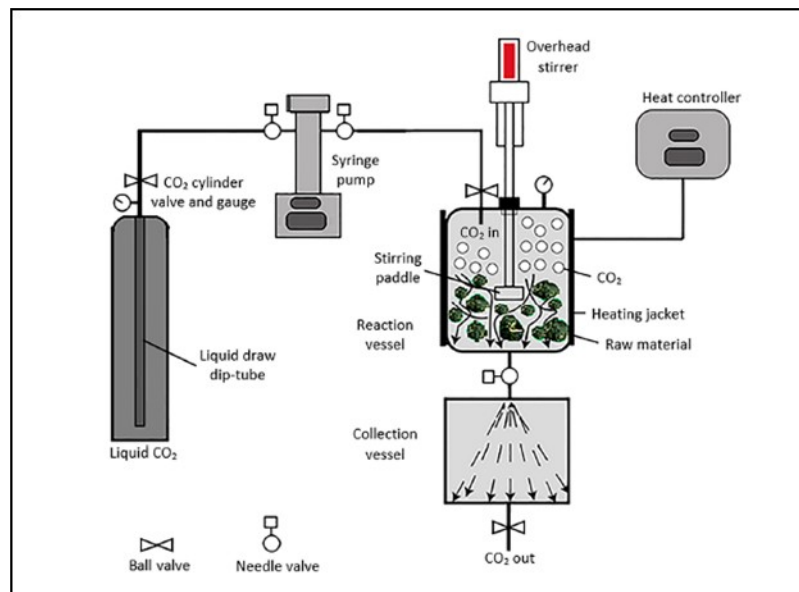
OVERVIEW OF EXTRACTION METHODS

Super Critical Carbon Dioxide (CO₂)

CO₂ gas is a solvent-based method for cannabis extraction first allowed by Health Canada in July 2015. Cannabis extraction was originally allowed in response to a ruling by the Supreme Court of Canada in June 2015. The ruling determined that medical patients should have access to all forms of cannabis, including distillates and oils. In July 2015, Health Canada issued a Section 56 exemption under the Controlled Drugs and Substances Act (CDSA). The first two cultivators to be awarded a Standard Processing License were Peace Naturals and Whistler Medical.

The CO₂ extraction method utilizes high temperatures (up to 57C (135F)) and high pressures (up to 5000 psi) to extract cannabinoids and terpenes from biomass (flower or trim). This method is named supercritical CO₂ because of the CO₂'s physical state is in between a liquid and a gas. When CO₂ is in gaseous state it cannot act as a solvent to remove the cannabinoids and terpenes from biomass. Additionally, in a liquid state, CO₂ is not an effective solvent. This is why energy has to be added in the form of high temperature and pressure to keep the CO₂ in a supercritical state (in between a liquid and gas) where the cannabinoids can be extracted. Typically, there is an initial extraction run of the biomass at lower pressures and temperatures (called subcritical) through the CO₂ system, which removes the terpenes. Once the first run is complete, a second run is initiated where the pressure and temperature are increased to extract the cannabinoids (supercritical). Then the biomass can be separated from the cannabinoids for further refinement and the terpenes are added back.

Figure 10: The Supercritical State Fluid Extraction



Source: MDPI- Solvent Supercritical Fluid Technologies

OVERVIEW OF EXTRACTION METHODS

CO2 Method Advantages:

- At high temperatures and pressure (supercritical), the cannabis can be manipulated to remove specific compounds, such as THCV, CBG, and CBN, which have the potential to be useful as active pharmaceutical ingredients (API). However, since this manipulation is done by optimizing the temperature and pressure, highly-trained chemists are needed, which results in high labour expenses (higher OPEX). However, any remaining CO2 from the process can be recaptured and used again, which will help cut costs.
- The supercritical CO2 process can be used to target specific cannabinoids and is very safe for the environment, however it is a lengthy process that incurs additional costs (OPEX, CAPEX, and R&D).
- As the process occurs without a traditional solvent, there are no residuals of solvent contaminating the final product, and there are only minimal losses of the initial material observed.

CO2 Method Disadvantages:

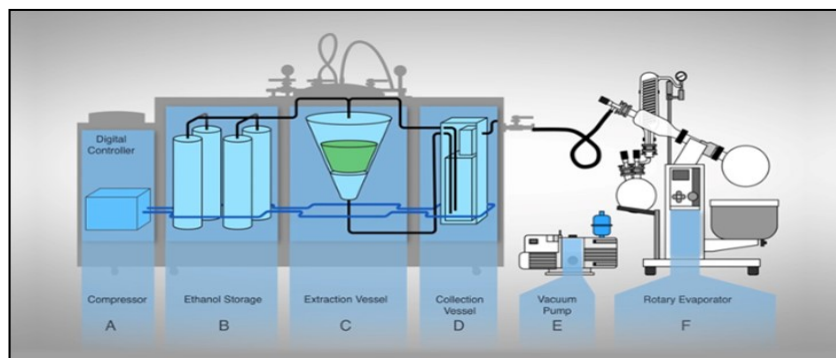
- Very dangerous because the high temperature and pressure used in the process requires a highly-trained chemists, typically PhDs, which incurs high OPEX.
- The methodology has a lower throughput (amount of biomass that can be processed) compared with other methods and lower scalability. Thus, to extract high volumes of biomass additional extraction machines (units) need to be added, which incurs high CAPEX requirements.
- A lot of energy is required to heat and pressurize the CO2, leading to additional OPEX requirements.
- Unwanted waxes and lipids are accumulated to undesired levels as a result of the supercritical process.
 - These need to be removed through a process called winterization.
 - Under the winterization process, extracts are soaked in ethanol to remove the waxes and lipids. To follow, the ethanol needs to be removed, which can take up to 12 hours, which creates a further bottleneck in the process.
 - The cannabinoids are then removed from the terpenes and then need to be added back.
 - This method does not preserve very well and creates an undesirable terpene profile for some users.

OVERVIEW OF EXTRACTION METHODS

Ethanol Extraction

Ethanol (aka ethyl alcohol) is a simple alcohol, and typically 200 proof is used. Ethanol-based extraction is an approved Health Canada extraction method, which has been used in Canada since the spring of 2018. However, Health Canada regulations require that less than 5,000 parts per million (ppm) of ethanol remain in the finished cannabis oil products. Under this method, the ethyl alcohol is injected through the plant cells, where the cannabinoids are absorbed into the alcohol. The biomass is then filtered out of the mixture and evaporated away using a rotor-evaporator. The resulting solvent (ethanol) can be collected and reused up to 20 times. Additionally, according to Health Canada regulations every extraction methodology requires the final product be winterized, to remove unwanted waxes and lipids.

Figure 11: The Ethanol Extraction Process



Source: Cannabis Tech

Ethanol Method Advantages:

- Safety and scalability.
- As this is one of the safer extraction methods, it is much less difficult to train operators in using the equipment and, thus, higher educated operators are not need as labourers to operate the units around the clock, leading to lower OPEX requirements.
- The system is much more scalable, throughput with an ethanol-based system is 25/kg of biomass per unit per hour (theoretically could scale to 60/kg), compared with CO2 systems, which can process ~2-5/kg of biomass per unit per hour, leading to lower CAPEX requirements.

Ethanol Method Disadvantages:

- The cannabis oil has a limited terpene profile.
- The process can pull chlorophyll from the plant, leaving a residual colour and taste to the final product.
- However, this can be removed in post-processing, which leaves a tasteless and odour-less product that can be used in other applications other than oil, such as vapes, topicals, edibles, and beverages. Once post-processing is complete the resulting cannabinoids (THC/CBD) can have a purity of 90%-95%.
- Additionally, the ethanol-based extraction process is very effective at removing unwanted waxes and lipids, which are not good for vape pens, as waxes or lipids can build up as black tar in the lungs.

OVERVIEW OF EXTRACTION METHODS

Hydrocarbon-Based Extraction

Hydrocarbon-based extraction is most commonly done with butane and propane. The following is a review of the process:

- The solvents are passed through the biomass in a liquid state, which dissolves the cannabinoids and terpenes into the solvents. The hydrocarbons bond to the fat-soluble cannabinoids and terpenes.
- The remaining biomass is separated from the liquid and removed.
- The solvent is then evaporated with boiling water, leaving cannabis oil.
 - This also needs to be done at very low temperatures, which aids in extracting more terpenes, specifically terpenes that are more sensitive to temperature compared with CO2 or ethanol-based extraction.
 - Also, less unwanted material, such as waxes or lipids, are collected under this method.
 - Health Canada regulations stipulate that less than 5,000 ppm butane or propane have to remain in the finish concentrate product.

Figure 12: Hydrocarbon Extractor



Source: National Hemp Association

Hydrocarbon Method Advantages:

- This method creates the richest cannabinoid and terpene profile without co-extracting chlorophyll.
- The low boiling temperature of butane and propane allow it to be easily removed from the cannabis oil.
- A wide array of products can be made with this method (shatter, budder, wax, batter, sap, syrup, and sugar).

Hydrocarbon Method Disadvantages:

- Butane and propane are highly flammable and can be dangerous, thus they require specialized staff (higher OPEX), also some of the hydrocarbons may be left in the final product.
- Requires a Class 1 Division 1 (CIDI) explosion-proof room (higher CAPEX), which is the highest requirement needed for working with combustible gases that have strict government regulations (safety equipment and special training for handling combustible gases) and are the most expensive to build, compared with other methods.

OVERVIEW OF EXTRACTION METHODS

Solvent-less Extraction (Bubble Hash, Pressure Rosin, and Steam Vac)

The most common solvent-less methods include bubble hash, pressure rosin, and steam vac distillation.

Figure 13: Bubble Hash Bags



Source: bubblebag.com

Bubble Hash

- Method of making hashish by sifting cannabis trichomes through ice cold water.
- Typically, the biomass is put in a bucket lined with eight perforated bags starting in size of 25 microns and ending in 220 microns.
- Water with ice is poured into the bag, mixed and then left to sit still for 30 minutes. As each bag is removed more of the biomass is removed, leaving a resin commonly called bubble hash.

Advantages of Bubble Hash:

- Safety, since there is no solvent used, no high/low temperatures or pressures are needed.
- The extract is a full-spectrum with a high terpene profile and potency resin.
- The process is very inexpensive, as such it is commonly used by cannabis connoisseurs at home.

Disadvantages of Bubble Hash:

- Cannot be done at scale and is labour intensive. However, it is solvent-less and leaves a high potency resin.
- Mold could be left over in the resin and there is no filtration and purification process.

OVERVIEW OF EXTRACTION METHODS

Figure 14: Pressure Rosin Press



Source: webhydroponics.com

Pressure Rosin

- Two hydraulic plates are used to squeeze the biomass under 300 psi, which is then heated and the discharge comes out between the two plates for collection.

Advantages of Pressure Rosin:

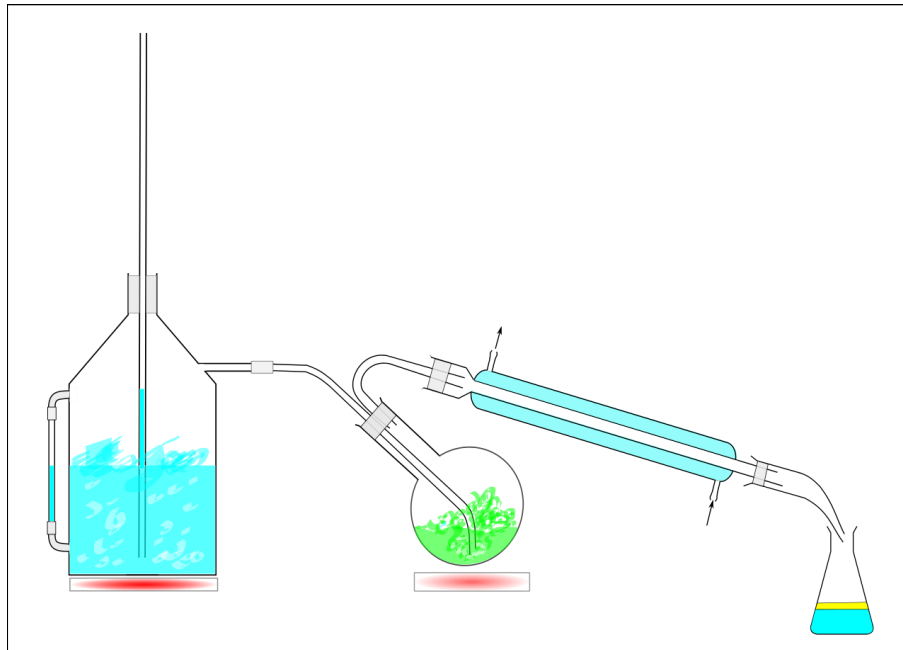
- Solvent-less method that provides full-spectrum extract.
- Low CAPEX and OPEX requirements.

Disadvantages of Pressure Rosin:

- This method is expensive and can be difficult to optimize, as hot plates can be dangerous to work with. In addition, the process is not 100% efficient, as a lot of biomass is wasted and it requires a large amount of material to work effectively.

OVERVIEW OF EXTRACTION METHODS

Figure 15: Steam Vac Distillation System



Source: researchgate.net

Steam Vac Distillation

- Biomass is suspended over a large cylinder of boiling water and the steam is guided through the biomass, which collects the cannabinoids and terpenes that are soluble to steam.
- The terpenes are infused into the steam and then once in a gaseous state they are moved into contact with a cooled condenser that liquifies the oils and water.
- The oils are lighter than water, so they float on top and are collected.

Advantages of Steam Vac Distillation:

- One of the more effective methods of isolating terpenes.
- As no solvent is used in the production process, the end product has no traces of contamination.

Disadvantages of Steam Vac Distillation:

- This process uses extreme heat and is very difficult to scale.
- Water boils at 100C (212F) - this has the potential to ruin many plant compounds if not done carefully.

Broadly speaking, solvent-less methods are more challenging and are typically not used in commercial applications due to their lack of scalability. Typically, they are used by craft growers to produce small amounts of resin. The THC/CBD cannabinoid content is usually lower with these methods, about 40%-60%, compared to ~95% with solvent-based methods.

THE FINAL STEPS: DISTILLATION AND REFINEMENT

Under the distillation process, individual cannabinoid and terpene isolates are separated and recaptured. This process is highly technical; however, it is a critical process in the manufacturing of some of the most specialized and high-margin products, such as vapes, edibles, and beverages.

Figure 16: Cannabis Distillation Equipment



Source: Root Sciences

The main difference between primary extraction and secondary extraction (distillation) is purity. In primary extraction, there are high concentrations of cannabinoids and terpenes, however, there is no isolation of specific cannabinoids. Through isolation (secondary extraction), concentration and purity can be increased further. Purity is especially important for products that are inhaled. Issues with products such as vape pens arise when distillate is not properly refined, or the wrong cutting agent is used. Cutting agents, such as propylene glycol or glycerin, can undergo decomposition when in contact with the heating element of a vape. On this point, studies have shown that volatile carbonyls, a carcinogenic, can be formed, which could have an adverse effect on health.

The refinement and purification process ensure that none of these compounds remain present in the distillate oil. Recently, on April 14, 2019, the Michigan Bureau of Marijuana issued a warning to vape users about inhaling metal and heavy lead from heating elements in vaporisers. Health Canada has [proposed](#) strict regulations on edible cannabis, extracts and topicals. These regulations cover packaging, additives, labeling, standardized THC/CBD content, in addition to amounts of leftover solvents from [processing](#) in ppm that are allowed in the final product.

Molecular separation is a process that converts the crude cannabis oil into separate compounds (cannabinoids). This process is done by thermal heating the crude oil until the cannabinoids become gas, which is then collected and condensed again into a viscous oil. Each cannabinoid has a different temperature at which it becomes a gas. Cannabinoids are isolated by heating the crude oil to their specific boiling point. Through this extraction process, companies can separate the different cannabinoids into high-purity formulation, which can then be used in edibles, beverages, or as an active pharmaceutical ingredient (API).

Distillation and refinement are very technical processes. There are an estimated 113 different cannabinoids that can be derived from the cannabis plant. However, more R&D is required to identify the specific boiling and melting points of each of the cannabinoids to further isolate them. The specific boiling and melting points of the 113 different cannabinoids will most likely end up being closely guarded trade secrets by companies who identify them. Additionally, they will likely be a point of differentiation for those companies. As such, they can be used in high-margin products or as pharmaceutical APIs.

NOTE ON QUALITY ASSURANCE

GMP vs cGMP vs EU-GMP vs. ISO 9001 vs. GPP

Good Manufacturing Practice (GMP) is a quality assurance standard used in the pharmaceutical, food and beverages, cosmetics, medical devices, and dietary supplements industries. The standard ensures that drugs or products are produced in a consistent manner so that their dosage and efficacy are standardised with little variation between batches (less than 5%), with the aim of preventing any harm to the end user.

In Canada, GMP protocols are monitored by Health Canada. Health Canada ensures facilities that operate under a GMP license use proper quality control, record keeping, standardized packaging, acquirement of raw materials from approved sources, maintain a clean premise, have personnel wear protective equipment, use proper sanitation, and conduct finished-product testing. GMP guidelines require LPs to control environmental variables on top of completing quality checks throughout the manufacturing process. More specifically for cannabis, product testing to screen for THC and CBD levels, tests for microbial contamination, and screening for pesticides and heavy metals must be completed.

cGMP, or current good manufacturing practices, is an additional FDA certification. cGMP maintains that its licensed facilities adhere to all GMP protocols. In addition, to maintain a cGMP license a facility must review their GMP protocols annually. In regard to a pharmaceutical company, it helps to reduce chances of contamination, error, and deviations. The certification requires the Company to review their protocols annually in order to implement the most up-to-date technologies and systems to comply with the regulation. In comparison to GMP, cGMP offers a more reliable quality assurance, due to the utilization of innovative technology and automation and has stricter guidelines to meet. These differences also result in cGMP being a more expensive qualification to achieve.

EU-GMP is very similar to the FDA's cGMP with a couple of differences. The first is regarding contamination control. EU-GMP puts a heavy focus on this, with the aim to prevent human exposure limits to certain adverse chemicals. Second, EU-GMP requires stricter supply chain traceability of source material. It is the manufacturer's responsibility to audit all suppliers to ensure they are EU-GMP compliant.

All licensed producers for medical marijuana are required to comply with Good Production Practices (GPP), which are designed to ensure the cleanliness of the property and equipment. Under GPP, producers are required to have steps in place to check for adherence to quality standards for the entire manufacturing process. GPP is the standard required in Canada, while in Europe LPs are usually required to follow GMP guidelines. When comparing GMP to GPP, GMP is more thorough in checking the quality of the cannabis.

OPPORTUNITY FOR MARKET SHARE IN CANADIAN RETAIL IS UP FOR THE TAKING

In Canada, unadjusted sales of cannabis in stores has grown by 107% between October 2018 and May 2019 (Figure 18). In our opinion, recreational cannabis sales are set to continue growing with the upcoming legalization of edibles expected in October 2019. With the increasing demand for cannabis products, there are concerns for Canada's ability to avoid a shortage of supply. For instance Ontario, the most populous province in Canada, currently has 25 retail locations. As it is a heavily-concentrated area for cannabis companies, with Canopy Growth and Aphria being headquartered in the province as well as the largest demand for cannabis at about 2.9M users, there is currently not enough retailers to meet demand.

Although Ontario is planning to license 50 new cannabis locations, this increase will only bring the number of users per retail location down by 66% to 194,244 people per retail location. Other provinces have similar limited resources, with Quebec and British Columbia being the two other most underserved markets with 54,926 and 16,947 users per retail location, respectively. Despite the limited access to purchase cannabis, Ontario, British Columbia and Quebec have experienced the largest growth in cannabis in-store sales between April 2019 and May 2019 with 16%, 37% and 26%, respectively. Overall, each province has experienced growth in the number of cannabis sales in stores per month. This highlights that with an already underserved market, Canada will have to start increasing the number retail locations per province to satisfy demand.

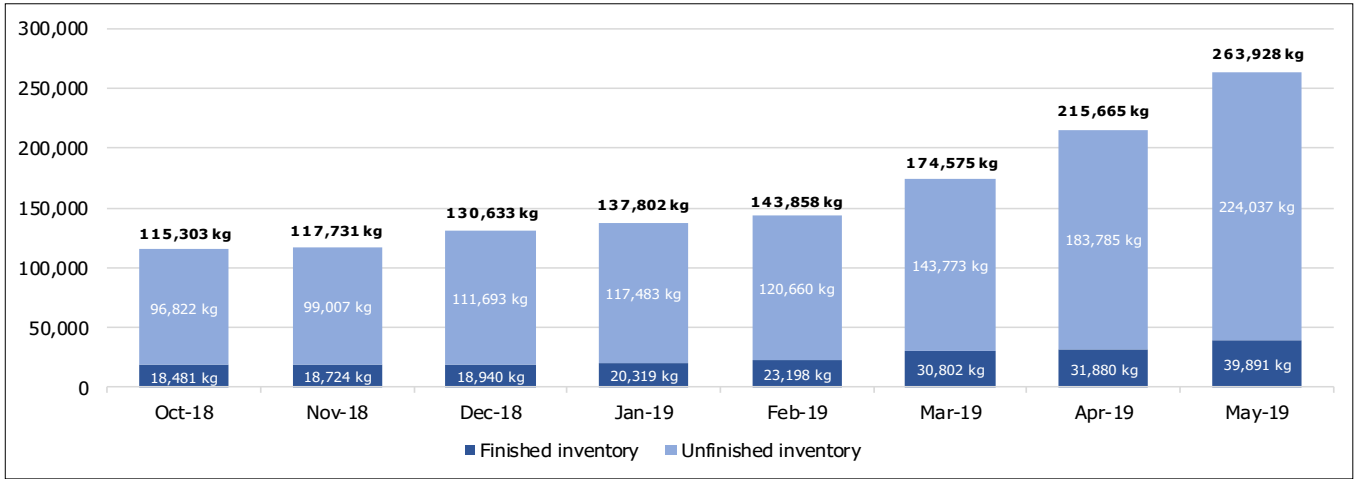
Figure 17: Statistics Canada Sales Data ('000s)

Province	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19
Newfoundland and Labrador	2,144	2,615	2,855	2,125	1,430	2,379	2,407	2,555
<i>Growth rate</i>		22%	9%	-26%	-33%	66%	1%	6%
Prince Edward Island	850	1,235	1,348	1,226	1,077	1,163	1,173	1,311
<i>Growth rate</i>		45%	9%	-9%	-12%	8%	1%	12%
Nova Scotia	4,451	6,365	6,422	5,408	4,610	4,986	4,929	5,284
<i>Growth rate</i>		43%	1%	-16%	-15%	8%	-1%	7%
New Brunswick	2,190	3,029	3,264	3,035	2,677	2,930	2,863	2,931
<i>Growth rate</i>		38%	8%	-7%	-12%	9%	-2%	2%
Quebec	9,416	11,859	11,993	11,218	11,389	14,107	13,598	17,130
<i>Growth rate</i>		26%	1%	-6%	2%	24%	-4%	26%
Ontario	11,454	8,920	8,721	8,947	7,539	7,692	19,687	22,821
<i>Growth rate</i>		-22%	-2%	3%	-16%	2%	156%	16%
Manitoba	n/a	n/a	4,163	3,894	4,067	4,782	4,894	5,231
<i>Growth rate</i>				-6%	4%	18%	2%	7%
Saskatchewan	2,462	2,330	2,497	2,542	4,070	5,071	6,060	6,851
<i>Growth rate</i>		-5%	7%	2%	60%	25%	20%	13%
Alberta	5,701	11,205	14,225	14,037	12,342	14,483	15,876	17,502
<i>Growth rate</i>		97%	27%	-1%	-12%	17%	10%	10%
British Columbia	270	1,077	1,239	1,963	1,926	2,844	2,532	3,470
<i>Growth rate</i>		299%	15%	58%	-2%	48%	-11%	37%
Yukon	n/a	n/a	403	337	289	331	327	328
<i>Growth rate</i>				-16%	-14%	15%	-1%	0%
Northwest Territories	n/a	n/a	205	144	246	175	237	231
<i>Growth rate</i>				-30%	71%	-29%	35%	-3%
Nunavut	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Canada	41,465	53,726	57,335	54,876	51,663	60,943	74,584	85,645
<i>Growth rate</i>		30%	7%	-4%	-6%	18%	22%	15%

Source: Statistics Canada, Ubika

OPPORTUNITY FOR MARKET SHARE IN CANADIAN RETAIL IS UP FOR THE TAKING

Figure 18: Canadian Cannabis Inventory



Source: Ubika, Statistics Canada

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