HARDMAN&CO.

Cannabis

A Blooming Industry

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Cannabis – a blooming industry

Introduction

Cannabis (a.k.a. weed, pot) has been consumed by human for millennia, whether for medicinal, therapeutic or recreational use. It is one of a few plants that exist in nature to be deemed illegal due to its psychotic effects when consumed. It is not until recent years / decades that countries around the world started legalising the use of cannabis and its derivatives.

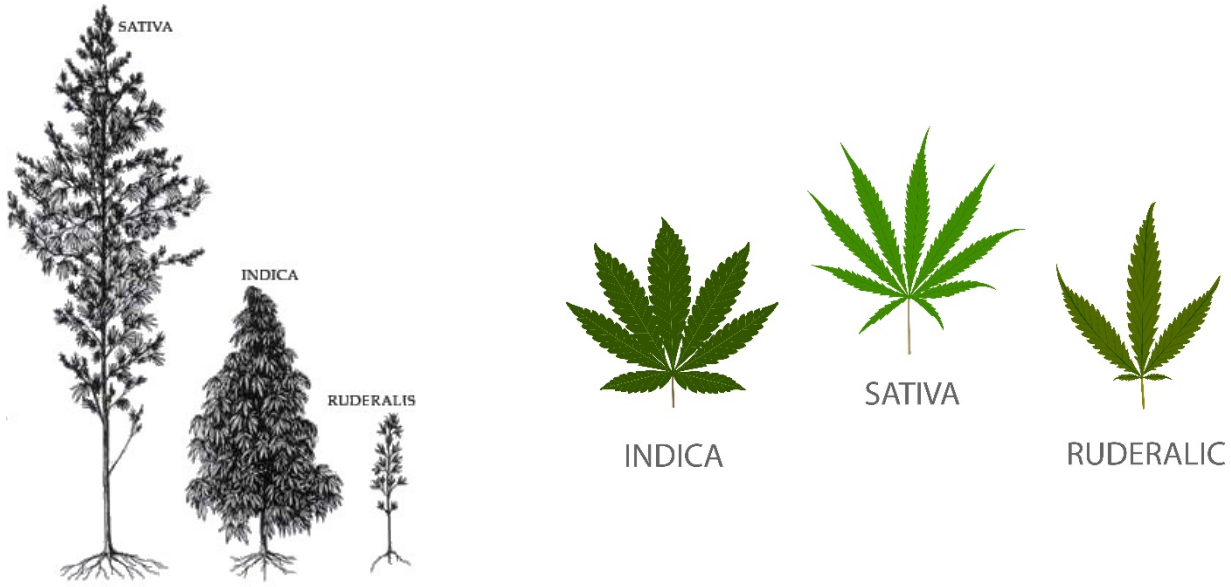
In this series, we are looking to demystify the cannabis sector. In this part, we are seeking to understand cannabis – the plant and its properties, as well as the extraction of its derivatives.

Cannabis – the plant

The basics

Cannabis is a genus of flowering plants in the Cannabaceae family, indigenous to Central Asia. There are three main cannabis species: *cannabis sativa*, *cannabis indica* and *cannabis ruderalis*. They are distinguished by their plant structures and leaves: *sativa* plants tend to be tall, thin and wispy, with relatively light-green and narrow leaves; *indica* plants tend to be shorter and bushier; *ruderalis* plants are the shortest of the three species, and typically have a higher CBD (cannabidiol) content. However, all cannabis plants contain cannabinoids, which interact with the endocannabinoid systems of both humans and animals. The majority of the hybrid varieties of cannabis (a.k.a. strains) that are cultivated today have been developed from these three species based on their characteristics.

Cannabis species



Source: Wikipedia, Shutterstock

Over 100 different cannabinoids inside the cannabis plant

There are more than 100 different compounds inside cannabis, known as "cannabinoids". These compounds, when consumed, react with the cannabinoid receptors in the users' nervous and immune systems. The biggest proportion of these cannabinoid compounds in most cannabis is THC (tetrahydrocannabinol), which is the compound responsible for the psychoactive "high" feeling commonly associated with cannabis consumption.

The second-biggest component of cannabinoid is CBD. At present, CBD is the key, most talked-about functional ingredient from the cannabis plant. It produces beneficial physical effects on the user, without the psychoactive effects associated with THC.

There are also a variety of compounds, called "terpenes", present in the cannabis plant. Terpenes exist in cannabis and other plants, and often have a strong odour, which helps to protect the plants from predators and attract pollinators. Terpenes are secreted in the same glands that produce cannabinoids, and because of their strong odours, they are responsible for the cannabis plant's aroma and flavour, such as citrus, berry, mint, pine, etc. Terpenes, when mixed with cannabinoids, also generate some physiological effects to the plant's properties that are sought by users.

Trichomes, meaning "hair", from its Greek name, are the resin glands of the cannabis plant that secrete cannabinoids and terpenes, and other compounds. They are hairline components that occur all over the cannabis plant, but are found in highest concentration on the unpollinated female flowers of the plants.

Cannabis flower and trichome

Source: Shutterstock

Cultivation

Six phases of growing process…

Most of the cannabis plants cultivated today are hybrid varieties developed from the three main species, *sativa*, *indica and ruderalis*. The majority of the commercial production of cannabis is restricted to varieties that yield high in fibre, while producing low levels of THC, the psychoactive cannabinoid.

A cannabis grower purchases the desired strain of existing cannabis seeds or clones from commercial seed producers, based on the plants' properties, such as aromas, flavours, percentage of active compounds, and other qualities demanded by its customers. The grower, depending on the cultivation methods deployed, aims to optimise the quality and quantity of the cannabis plant's yield by adjusting the cultivation inputs, such as light, nutrition, air, drying and curing time.

…seed selection, seedling, vegetative, flowering, harvesting, drying

It takes around three to 10 months to grow and cure cannabis plants. In general, the process can be categorised into six phases: seed selection, seedling, vegetative, flowering, harvesting and drying.

There are, in general, four types of cannabis-growing facilities:

- **Indoor:** These are the most input-intense cultivation facilities. Cannabis is grown under lighting, and the growing environment is completely controlled. It is also the most expensive way to grow, but it tends to yield a higher quality of cannabis, because of the absolute control over the input variables. Indoor growing facilities also require a significant amount of lighting, which includes traditional fluorescent lights and LED lights, where the plants are grown in soil, hydroponic systems or aeroponic systems. This cultivation method is most common in Canada and in some parts of the US, where climatic conditions are not suitable for outdoor cultivation. However, growing cannabis in indoor facilities requires a lot more energy to power the high-intensity lightings, hence render this growing method relatively unsustainable.
- **Outdoor:** Cannabis is grown outdoors, and is exposed to the elements. These are generally less expensive than indoor facilities, and are more suitable for large-scale projects. Given that the plants are exposed to natural elements, the grower has less control over the growing conditions – hence the number of harvests per year is limited. Outdoor cannabis cultivation is also subject to much stricter zoning laws.
- **Greenhouse:** Cannabis can be cultivated under filtered sunlight, and the growing environment can be partially controlled.
- **Hybrid:** Some facilities combine features of greenhouse and indoor facilities. For example, greenhouses can rely primarily on sunlight, but also use electrical lighting as a supplement during the plant's flowering cycle.

Growing cycle of cannabis plant

Start	•Seed selection: by choosing the strain with a particular cannabinoid and terpene profile that is desired by the cultivator. In the case of THOG, seeds are selected for their high CBD content, while THC level is low, and its flowers are feminised.
1-4 weeks	•Seedling: seeds start to spout.
3-16 weeks	•Vegetative stage: rapid growth stage and revelation of sexual characteristic. Cultivators typically remove male plants and control inputs in this stage to maximise the unpollinated female flowers, which contain the highest concentration of compounds.
6-16 weeks	•Flowering: this is the stage when the plants flower and mature, with trichomes growing on the flowers. Trichomes have higher concentration on the unpollinated female flowers.
2-4 weeks	•Harvesting means clipping the leafstalks where the flowers grow. This timing can vary to maximise the flower yield and the cannabinoid and terpene content.
2-8 weeks	•Drying: by controlling the fermentation process during the drying process to optimise the aroma and cannabinoid composition.

Source: Hardman & Co Research

Extraction and refining

Extraction

Extraction is the process in which resinous trichomes are separated from the cannabis plant. There are multiple methods of extraction currently being used in the industry. In general, extraction techniques can be grouped into two categories: solvent-based extraction and solvent-free extraction techniques.

Multiple extraction methods in industry

- **Solvent-based extraction techniques** normally include the use of hydrocarbon, carbon dioxide and ethanol solutions to chemically isolate cannabinoids and other compounds. This extraction technique is relatively time-efficient and, technically, can provide better yields. However, the downside of the solvent-based technique is that it is more costly, because of the expensive equipment and skilled labour required. It may also leave residual solvents in the concentrate.
- **Solvent-free techniques** require the use of filters, ice water or heat to physically separate the cannabis plant with high cannabinoid concentrates. This technique, in general, is relatively inexpensive, and it can be performed without specialised equipment. The downside of this technique is that it is time-consuming and labour-intensive, and, in general, results in lower yields.

Solvent-based extraction

Ethanol extraction: This method is very common within some industries that require the extraction of essential oils and flavourings from plants. In cannabis extraction, the process involves immersing the cannabis plant in ethanol, which separates cannabinoids, terpenes and other compounds from the plant. The solution will then be heated until the alcohol evaporates.

The equipment required for ethanol extraction is less expensive than that required for the hydrocarbon method, and is less power-intensive than the CO_2 technique. However, the ethanol also extracts other compounds that are less desirable, such as chlorophyll. As a result, the method requires a significantly higher level of secondary processing to purify the end-product.

Hydrocarbon extraction: This is the most popular extraction method. It utilises a hydrocarbon solvent, such as propane and butane, to extract cannabinoids, terpenes and other components chemically. The process then uses heat and pressure to remove the solvent, which leaves a concentrated form of the extracted compounds.

The highly concentrated extract is used to produce cannabis oils (BHO – butane hash oil/PHO – propane hash oil), shatter, glass, hash, wax and other products.

The downside of this technique is that the solvents used are explosive, meaning that extraction facilities need to be tightly controlled to avoid fire hazards, as well as the possibility of residual solvents in the concentrated compound. Regulations are becoming more restrictive in specifying the acceptable level of residual solvents in the end-products.

CO_2 extraction: This is a supercritical extraction process. The cannabis plant is introduced into a system of pressurised carbon dioxide (at a point where the CO_2 exhibits in both gas and liquid states). This process is designed to pull the desired phytochemicals (i.e. cannabinoids, terpene oils and wax) from the cannabis plant. The pressure is then released, and the CO_2 vaporised, leaving the concentrated extract.

This extraction process is considered to be relatively safe and clean. It is commonly used to produce viscous CO_2 oil for vaporiser cartridges and low-terpene concentrates for infused products. However, the required extraction equipment for this process is relatively more expensive than the other methods, and has a much higher energy requirement.

Solvent-free extraction

Solvent-free extraction products include dry sift hash, ice water hash and rosin.

Dry sift hash (or Kief): This method utilises some super-fine micron screens to filter the trichomes from the plant material, mainly by tossing the cold buds back and forth across a fine filter screen. The dry sift, aka Kief, is then collected together and pressed into blocks.

Ice water hash: As stated in the name, this process utilises ice-cold water to soak the cannabis flowers and then, typically with the aid of a bubblator machine, to agitate the solution. The trichomes are not water-soluble, so do not dissolve as they would in a solvent-based extraction technique. Instead, the trichomes are broken off from the plant material using a mechanical motion. They are then collected in micron filter bags and dried.

Rosin: The extraction process takes place by applying heat and pressure to press out cannabis resins.

Cannabinoids

More than 100 cannabinoids identified in cannabis plant

Cannabinoids are the compounds in the cannabis plant that act on cannabinoid receptors on both human and animal endocannabinoid systems. There are more than 100 cannabinoids identified in the cannabis plant. In general, the most abundant is THC, a psychoactive compound that causes what is commonly known as the "high" sensation. The second-most abundant compound is CBD, which is responsible for producing relaxing physical results, without the psychoactive effect.

The most common conditions treated by medical cannabis that have been legalised under US State laws are Alzheimer's, chronic pain, epilepsy, inflammation, multiple sclerosis and Parkinson's.

Some of the most commonly talked-about cannabinoids are listed below:

- **THC (tetrahydrocannabinol):** This is the most abundant cannabinoid in cannabis, and it is understood to be the psychoactive compound in the plant that is responsible for the feeling of being "high'". THC is thought to have wide-ranging medicinal benefits – antibacterial, antidepressant, anti-inflammatory, etc.
- **CBD (cannabidiol):** This is the second-most abundant cannabinoid in the plant. It is not psychoactive, unlike THC, which is. CBD is believed to have wide-ranging medicinal benefits – antianxiety, antibacterial, antidepressant, anti-inflammatory, anti-insomnia, antipsychotic, antispasmodic, etc. In addition, CBD is believed to have therapeutic benefits – appetite stimulation, bone-growth stimulation, neuroprotection, etc. CBD can be derived from many strains, including the now widely popular low-THC strains that are grown to produce industrial hemp products.
- **CBN (cannabinol):** CBN has been shown to produce psychoactive effects, and is believed to have benefits, such as antibacterial, anticonvulsive, anti-inflammatory and anti-insomnia. Unlike many other cannabinoids, CBN results from THC degradation. The CBN level is sometimes used as a measure of the plant's overall quality for consumption.
- **THCA (delta-9-tetrahydrocannabinolic acid):** THCA is found in abundance in raw cannabis flowers, and is the precursor to THC. However, THCA is non-psychoactive, and has medicinal benefits, such as anticancer, anti-inflammatory and antispasmodic. THCA can be decarboxylated into THC through drying, or processed using intense heat; for example, the heat applied during smoking or vaporising the cannabis plant.

THC and CBD can be found in abundance in many cannabis strains, with other cannabinoids found in only small amounts. THC-dominant strains historically have been the most popular with users; however, CBD-dominant strains that contain low-THC, such as the strains grown to produce industrial hemp, have gained in popularity, given their medicinal benefits and therapeutic claims.

Terpenes

Terpenes are organic compounds found in plants, including cannabis, and are found in the highest concentration in the flowers of the cannabis plant. Terpenes give the plants their aromas and flavours. The strong odours given out by terpenes are believed to be part of the plants' natural defence mechanism. Terpenes interact with cannabinoids and contribute to the medicinal and therapeutic benefits.

More studies are required to better understand the mechanisms and effects of terpenes. It is widely accepted that consumption of cannabis strains with particular terpene profiles and aromas are associated with certain experience. For example,

the smell of musk or clove tends to have sedative and relaxing effects, while piney smells are associated with promoting focus and memory retention.

Human and animal endocannabinoid system

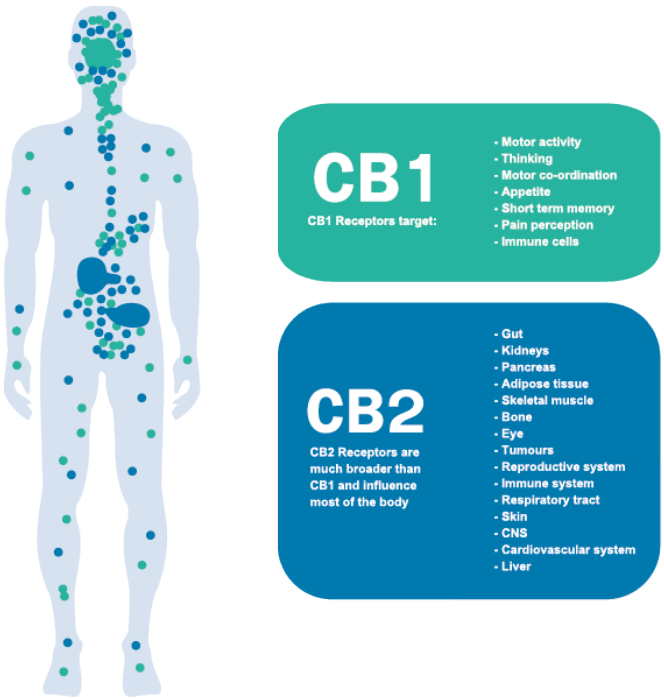
Receptors for regulating health and physiological functions…

The human endocannabinoid system consists of nervous and immune system receptors for regulating health and physiological functions. There are two types of endocannabinoid receptors, CB1 and CB2. CB1 receptors are found primarily in the brain and central nervous system, as well as in peripheral organs and tissues. These receptors help regulate memory, mood, sleep and pain sensation. CB2 receptors are located primarily in peripheral organs associated with the immune system, with the greatest concentration in the spleen, and are responsible for managing inflammation and autoimmune function. There are also many tissues containing both CB1 and CB2 receptors, with each linked to different functions.

…to help anxiety, depression, inflammation, insomnia, neural disorder, pain management

The physiological effects from cannabis consumption are the results of different cannabinoids bonding with the body's endocannabinoid receptors and, as a result, affecting the functions regulated by the system. Medical research suggests that cannabinoids can be used to help with anxiety, depression, inflammation, insomnia, neural disorder and pain management, etc.

Human endocannabinoid CB1 and CB2 receptors



Source: Shutterstock

Human endocannabinoids

Endocannabinoids are the cannabinoids created naturally by the body for delivery to CB1 and CB2 receptors. Endocannabinoids are broken down quickly by the body, unlike cannabinoids, which are introduced to the body through cannabis consumption, and the effects are usually short-lived.

Animal endocannabinoids

Mammals, such as dogs, cats and horses, also have endocannabinoid systems that are similar to humans. They have both CB1 and CB2 receptors that function in a similar way to humans. The cannabinoids found in cannabis, particularly CBD, have been shown to have a range of therapeutic applications for certain animals, the most well-known being their antibacterial and anti-inflammatory properties, as well as for pain relief.

Cannabis consumer products

Use of consumption broadly categorised into flower, concentrate, infused products

There are many different forms in which cannabis can be consumed, but it can be broadly categorised into flower, concentrate and infused products. Historically, the most popular way to consume cannabis has been smoking the flower or bud from the plant. The flower can also be vaporised and inhaled (such as using a product known as a vaporiser), where the active compounds from the plant are extracted and concentrated into oil or wax-like substances called concentrates. Concentrates can also be infused into other products, i.e. infused products, such as topical creams/lotions or food and drinks, capsules, tinctures, etc.

When the vapor from the heated flower or concentrate is inhaled, the active ingredients / compounds travel directly to the central nervous system of the user and the physiological effects normally begin within a few minutes. This compared to ingesting infused products, such as food and drinks, that need to go through the digestion systema and be metabolised by the user, the effects will take much longer to take place.

Traditionally, joints (i.e. a rolled up cannabis cigarette) had been the most widely used form of cannabis consumption. However, according to New Frontier Data, edible cannabis products overtook the classic flower-only joints as the preferred product forms among consumers under the age of 55 in 2020. We expect this trend to continue as number of cannabis products continues to increase, and consumers become more and more sophisticated and educated about the effects of cannabis and its derivatives, as well as brands' continual efforts in product innovation.

Conclusion

Cannabis is probably the most commonly used illicit drug around the world and has been a sector subject to significant legalisation scrutiny worldwide. Cannabis legalisation has definitely accelerated internationally. In November 2020, the European Court of Justice ruled that CBD should not be considered a narcotic under the 1961 UN Convention. It also stated that CBD 'does not appear to have any psychotropic effect or any harmful effect on human health.' This landmark ruling has significant implications in Europe, where the marketing authorisation applications of CBD Novel Food products were frozen prior to this ruling from the European Court of Justice.

We believe that the industry around CBD will continue to boom in the coming years. As the legalisation trend of cannabis sector around the world continues, it will provide a broad range of investment opportunities in both the private and public markets. We will explore more around the legal and investment landscape of the cannabis sector in our next report.

About the author

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Yingheng Chen is a senior financial analyst at Hardman & Co.

Yingheng has particular experience in the markets for palm oil, cocoa, citrus, coconut, Jatropha and sugar. She worked as a corporate finance analyst at the Agricultural Bank of China, and is fluent in Cantonese and Mandarin. She has a thorough understanding of the Chinese financial and business markets, as well as of those in the UK.

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