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TEST REPORT **REPORT NO.: 20-03-16321**

CHEMICAL/MICROBIOLOGICAL ANALYTICAL REPORT

Nature of Product: CBD Massage Oil Spray Sample.

Date of Report: 23th. March 2020.

Sample Volume: 100mls.

Holistic Hemp Scotland Limited

Auchentinny Cairn Road

Northmuir

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Scotland.

For The Attention of: Mr. Alex Sikorsky

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Date of Sample: 9th. March 2020.

TEST REPORT **REPORT NO.: 20-03-16321**

Part A – Product Safety Microbiological Analysis

Method of Analysis: Manual Pour Plate Method

Microbiological Analysis

Parameter	Method of Analysis	Method Reference	Units	Reported Levels
Staph. aureus	Pour Plate Count	APHA 9222	CFU/ml.	ND
Salmonella spp.	Pour Plate Count	APHA 9222	CFU/ml.	ND
Listeria spp.	Pour Plate Count	APHA 9222	CFU/ml.	ND
Bacillus cereus	Pour Plate Count	APHA 9222	CFU/ml.	ND
Clostridia spp.	Pour Plate Count	APHA 9222	CFU/ml.	ND
Enterobactericeae	Pour Plate Count	APHA 9222	CFU/ml.	ND
Esch. Coli	Pour Plate Count	APHA 9222	CFU/ml.	ND
Yeasts/Molds	Pour Plate Count	APHA 9222	CFU/ml.	ND

Part B – Product Safety Chemical Analysis

Method of Analysis: Inductively Coupled Plasma – Optical Emission Spectroscopy ICP-OES

Heavy Metals Analysis

Parameter	Method of Analysis	Method Reference	Units	Reported Levels
Mercury as Hg.	Cold Vapour AAS	EC 1881	CFU/ml.	< 0.002
Chromium as Cr.	ICP-OES	EC 1881	CFU/ml.	< 0.002
Arsenic as As.	ICP-OES	EC 1881	CFU/ml.	< 0.0005
Cadmium as Cd.	ICP-OES	EC 1881	CFU/ml.	< 0.003
Nickel as Ni.	ICP-OES	EC 1881	CFU/ml.	< 0.002
Lead as Pb.	ICP-OES	EC 1881	CFU/ml.	< 0.002

Note on Pathogens in Cannabis sativa products.

The most infamous serotype of pathogenic *E. coli* is O157:H7, but there are other types that can make the consumer sick. These nasty bugs are transmitted via a faecal to oral route, meaning that they are present in the intestines of animals, including humans. Contact with excreted material that harbours these germs or contaminated water sources, will result in transmission of *E. coli* cells, which may colonize cannabis. This germ is widely associated with beef. However, raw produce that has not been processed via a heat-kill step has been identified as a vehicle for *E. coli* transmission. *E. coli* can be controlled for with a stringent hand washing policy, QC of any organic fertilizers, treated water, and zero animal contact with plants, including instruments that have been in contact with animals. Vegetative cells can be eradicated with an appropriately monitored dry step, but this will not remove any DNA evidence left behind which can insinuate unsanitary processing conditions.

According to the FDA, while S*almonella* has traditionally been associated with animal products, there has been a spike in *Salmonella* outbreaks from produce and ready-to-eat food items. This is partially owed to the ability of this germ to persist in a dry environment with high plant metabolite content, such as spices. *Salmonella* is also transmitted via faecal oral route and there are serotypes that can be found in contaminated water supplies. Controlling *Salmonella* is similar to controlling *E. coli* within a production environment. Proper hand-washing, QC of raw materials used within the production of cannabis flower, treating the water, and no contact with animals or instruments that have come in contact with animals, is sufficient to control for bacterial pathogen contamination, including *Salmonella* contamination in most cases.

What makes Listeria unique is that serotypes of this genus have the ability to survive in salty environments and grow at temperatures as low as 1° C. While a majority of recorded outbreaks of this group of bacteria are linked to processed animal products, raw produce can harbour this bacterium as well, along with finished processed food items, such as ice cream. Like *Salmonella*, *Listeria* is a hardy germ, it has been recorded that the same isolates have been isolated from the same production facility over a 12-year span in one case. There have been instances where the FDA has put a facility on notice or completely suspended facilities that could not control *Listeria spp.* emergence on the production site, asserting that the environment presented a high level of risk to consumers of products processed within the facility. Processors must be very diligent in monitoring for this type of bacteria and ensuring that it does not contaminate high traffic areas within a facility or is not already present within a facility to be purchased, as it is particularly difficult to eradicate. Environmental swab assays can be of major help in finding unwanted microbial species within a cultivation environment so that the area may be thoroughly sanitized and re-swabbed to ensure complete eradication.

Note on Heavy Metals in Cannabis sativa products.

Depletion of the ozone layer and global warming are two of the biggest issues at hand due to the release of toxic pollutants into the environment. Inorganic pollutants include Heavy Metals such as Fe, Mn, Zn, Cu, Mg, Mo, and Ni, which are necessary for plant growth but are detrimental to the environment at high concentrations in the soil. Leaching of these metals into surrounding areas through rainwater runoff poses a dangerous environmental and health risk. Metals with an unknown biological purpose such as Cd, Cr, Pb, Co, Ag, Se, and Hg can also become accumulated and in high amounts be toxic. Phytoremediation is a natural, cost-effective process in which plants are used to remove unsafe compounds from the soil. Many plants have been studied and deemed effective at removing toxins from the soil. However, only a small number of those plants have numerous beneficial applications outside of phytoremediation. Methods of extraction and disposal of these plants have not been well defined.

Industrial hemp has been reported to be a hyperaccumulator. Studies have confirmed metal accumulation in both hemp roots and above ground tissues without noticeable changes in plant growth and morphology. However, the mechanism of accumulation remained unexplained. Significantly, hemp's short growing cycle, decreased need for pesticides, and low plant maintenance makes it an ideal candidate for phytoremediation studies.

Bioaccumulation of heavy metals can be a useful feature for farmers looking to decontaminate their soil, but it's bad news for cannabis producers. When cannabis absorbs and stores environmental contaminants like heavy metals in its stems, stalks, leaves, and flower, it poses a health risk to cannabis consumers.

Some heavy metals are more dangerous than others. The U.S. FDA highly regulates these heavy metal elemental impurities which pose toxicological risks to patients without providing any therapeutic benefit.

Mercury, Cadmium, Lead, and Arsenic are especially toxic, even in very small amounts.

Mercury exposure occurs through the skin or when Mercury is consumed. Even small amounts can lead to loss of coordination, muscle weakness, loss of memory, and trouble speaking, hearing, and seeing.

Cadmium exposure can cause flu-like symptoms including chills, fever, and muscle pain, as well as damage to the lungs if inhaled. Chronic exposure causes kidney, bone, and lung disease.

Lead is toxic when inhaled or swallowed and no amount of lead exposure is considered safe. This heavy metal interferes with enzyme function. As a result, major organs such as the kidneys, heart, and brain will eventually fail with high enough exposure to lead.

Arsenic also affects nearly every major organ system in the body by inducing cell death. Acute Arsenic poisoning results in vomiting and abdominal pain and chronic exposure can lead to heart disease and cancer.

Part C – Product Safety Chemical Analysis

Method of Analysis: High Performance Liquid Chromatography-Mass Spectrometry HPLC-MS-MS

Pesticide Residues Analysis

Parameter	Method of Analysis	Method Reference	Units	Reported Levels
Organochlorine	HPLC-MS-MS	APHA 6630	µg/ml.	< 0.002
Organophosphorus	HPLC-MS-MS	APHA 6630	µg/ml.	< 0.002
Organonitrogen	HPLC-MS-MS	APHA 6630	µg/ml.	< 0.050
Carbamate Pesticides	HPLC-MS-MS	APHA 6630	µg/ml.	< 0.030
Pyrethroid Residues	HPLC-MS-MS	APHA 6630	µg/ml.	< 0.001
Organotin	HPLC-MS-MS	APHA 6630	µg/ml.	< 0.002

Part D – Product Safety Chemical Analysis

Method of Analysis: High Performance Liquid Chromatography-Photodiode Array Detection HPLC-PDA

Aflatoxins/Mycotoxins Analysis

Parameter	Method of Analysis	Method Reference	Units	Reported Levels
Ochratoxin	HPLC-PDA	EC 401	µg/ml.	< 0.01
Aflatoxins Scan	HPLC-PDA	EC 401	µg/ml.	< 0.01
B1	HPLC-PDA	EC 401	µg/ml.	< 0.002
B2	HPLC-PDA	EC 401	µg/ml.	< 0.05
G1	HPLC-PDA	EC 401	µg/ml.	< 0.001
G2	HPLC-PDA	EC 401	µg/ml.	< 0.005

Part E – Product Safety Chemical Analysis

Method of Analysis: Method of Analysis: Gas Chromatography- Flame Ionization Detection GC-FID

Residual Solvents

Parameter	Method of Analysis	Method Reference	Units	Reported Levels
Methanol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.05
Pentane	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.02
Ethanol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.05
Diethyl Etyher	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.008
Acetone	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.03
Isopropyl Alcohol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.05
Acetonitrile	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.05
Dichloromethane	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.001
n-Hexane	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.02
Ethyl acetate	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.05
Chloroform	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.005
Benzene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.002
Tetrachloromethane	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.001
1,2-Dichloroethane	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.001
Heptane	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.02
Trichloroethylene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.02
Toluene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.002
Xylenes (Total)	GC-FID	Shimadzu HS-GC-FID	mg/ml.	< 0.002

Note on Pesticide/Herbicide Residues in Cannabis sativa products.

Pesticides, Herbicides, Antifungals, and performance enhancement reagents have been applied to cannabis, just as they are to other crops, to increase yields and prevent attacks from insects and mould. However, many of these chemicals and reagents may have harmful effects on humans, animals and the environment, especially people who grow or work with the products for a long period of time. In addition, when smoking plant materials such as tobacco and cannabis products, highly complex mixtures of compounds can be generated, many of which can interact with the chemicals (such as pesticides) present in the initial product to form even more toxic materials. Unsurprisingly, pesticide residues are found in the smoke produced by cannabis that has been grown using pesticides. Therefore, it is important to have a highly sensitive and selective testing method for the analysis of pesticides and other toxic chemicals to control the quality of cannabis products and evaluate the risk to consumers.

The QuEChERS method, which is based upon solid phase extraction is practical for pesticide, cannabis actives, mycotoxins and terpene analysis and is increasingly being employed on more difficult plant matrices such as cannabis. The problem is this process is a time consuming manual multi-step process. Headspace solid-phase microextraction (HS-SPME) has been used to identify and quantify Terpene content in cannabis. The HS-SPME method is superior to solvent extraction as it provides a cleaner analysis, has no interferences from coextracted matrix, and is non-destructive to the sample.

Note on Aflatoxins/Mycotoxins in Cannabis sativa products.

The cultivation conditions for cannabis plants create an ideal environment for the growth of molds and fungi, which, if allowed to proliferate, can begin to produce chemical mycotoxins. These mycotoxins are a known risk within the food safety industry, and have been linked to kidney and liver damage, reproductive disorders, and immune suppression. Particularly dangerous are the aflatoxins, a type of mycotoxin produced by some Aspergillus fungi species, which are potent carcinogens. Even acute exposure can be life threatening if the dose of aflatoxin is large enough, as the resultant aflatoxicosis can cause severe liver failure.

Cannabis material can also be contaminated with Mycotoxins during transportation, storage, and processing. Given the health risks associated with exposure to these mycotoxins, it's considered essential for the sake of consumer safety that mycotoxin analysis is carried out as part of the product's normal testing regimen.

When it comes to mycotoxin and aflatoxin testing, the regulations are perhaps surprisingly more uniform across the United States than one may expect. Firstly, almost all state testing requirements tend to focus on five mycotoxins in particular: aflatoxins B1, B2, G1, G2, and ochratoxin A.

While there are more than twenty aflatoxins known to scientists, these four aflatoxins (B1, B2, G1, and G2) have been identified as the most dangerous to human health. Additionally, aflatoxins B1 and B2 can be metabolized by the body to produce aflatoxins M1 and M2 which also pose various health risks, including carcinogenicity and genotoxic activity. Ochratoxin A is a concern as, while its exact health effects on humans are unclear, overexposure to the toxin has been linked to kidney damage and related cancers.

Note on Residual Solvents in Cannabis sativa products.

CBD Hemp Oil, produced by extraction of the flower buds of the cannabis sativa plant, has reputed therapeutic benefits. The extraction process typically involves solvents such as hexane or some alcohols that may remain in the final product.[3] The residual solvents are typically measured using Headspace analyzer interfaced directly to a GC. Solid phase microextraction (SPME) is an alternative approach that is often faster and easier to use. The method outlined here uses SPME with GC/MS finish to measure solvents in hemp extract. Hemp and marijuana are both varieties of cannabis sativa, however hemp is a variety that is very low in THC content.

High-quality concentrates offer consumers abundant levels of cannabinoids in smaller doses. Potent extracts with higher concentrations of terpenoids provide maximal effect, with a superior flavour. To create these concentrated extracts, producers will sometimes use hydrocarbon gases like butane and propane, as well as common solvents like ethanol, isopropanol, and hexane to bring out the essential oils.

After post-extraction processes like winterization, vacuum and heat, residual solvents remain behind. These ingredients can be ingested or inhaled by users in appreciable quantities. Even if one is performing a solvent-less extraction with dry sieve, carbon dioxide, or water, solvents are often used in cleaning the equipment and can end up in the final product regardless. That is why testing is crucial for patient safety. Testing can also give producers a clue as to the purity of their source materials.

The presence of solvents like pentane and isopentane can indicate that the butane or propane used for extraction were of poor quality. Similarly, food grade ethanol obtained by permit is safe to consume, but chemical grade ethanol produces residual solvents like methanol and isopropanol at levels of 4-10%.

Hexane is the only Class 2 solvent routinely found in cannabis extraction solvents. Hexane is a petroleum distillate that has been linked to respiratory irritation, dermatitis, liver and kidney failure, and Parkinson's Disease. Hexane levels should be as low as possible to avoid unwanted side effects.

Extraction solvents may also include contaminates like benzene and xylenes – Class 1 solvents and known carcinogens. While it may be more cost-effective, the potential health effects are cause for concern.

Part F – Product Quality Chemical Analysis

Method of Analysis: High Performance Liquid Chromatography-Photodiode Array Detection HPLC-PDA

Cannabinoids Analysis

Parameter	Method of Analysis	Method Reference	Units	Reported Levels
Cannabidiol CBD.	UHPLC-MS-MS	JHG-249	mg/ml.	2.245
Cannabigerol CBG.	UHPLC-MS-MS	JHG-249	mg/ml.	0.075
Cannabichromene CBC.	UHPLC-MS-MS	JHG-249	mg/ml.	0.053
Delta-9-Tetrahydrocannabinol THC.	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected
Delta-9-Tetrahydrocannabinolic acid THC-A.	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected
Cannabidiol acid CBD-A	UHPLC-MS-MS	JHG-249	mg/ml.	0.462
Cannabigerolic acid CBG-A	UHPLC-MS-MS	JHG-249	mg/ml.	0.035
Cannabidivarin CBDV	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected
Cannabidivaric acid CBDV-A	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected
Tetrahydrocannabivarin THCV	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected
Tetrahydrocannabivaric acid THCV-A	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected
Cannabinol CBN.	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected
Cannabicyclol CBL.	UHPLC-MS-MS	JHG-249	mg/ml.	Not Detected

Comment:

Result of Delta-9-Tetrahydrocannabinol (THC) and Delta-9-Tetrahydrocannabinolic acid (THC-A) of less than 0.0005% is based on Limit of Detection (LOD) for the Instrumentation used in this method. This is the smallest concentration of analyte that can be reported and is based on analysis of a minimum of 7 spiked samples and 7 method blank samples.

Part G – Product Quality Chemical Analysis

Method of Analysis: Gas Chromatography- Flame Ionization Detection GC-FID

Terpenes Analysis

Parameter	Method of Analysis	Method Reference	Units	Reported Levels
ß-Caryophellene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	4
Myrecene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	12.50
ß-Sitosterol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	3.50
Terpinolene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	6.50
A-Pinene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	9.35
ß-Pinene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	11
Bergamotene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	5
Limonene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	14.50
Merolidol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	4.80
Linalool	GC-FID	Shimadzu HS-GC-FID	mg/ml.	9.15
Humulene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	6
Bisabolol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	3.80
Valencene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	2.40
Terpineol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	4.75
Borneol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	1.55
Delta-3-Carene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	Not Detected
(Z)- ß-Ocimene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	1.50
(E)- ß-Tarnesol	GC-FID	Shimadzu HS-GC-FID	mg/ml.	Not Detected
Eremophelene	GC-FID	Shimadzu HS-GC-FID	mg/ml.	Not Detected
Geranyl acetate	GC-FID	Shimadzu HS-GC-FID	mg/ml.	Not Detected

Note on Cannabinoids Profile in Cannabis sativa products.

There are over 480 natural components found within the Cannabis sativa plant, of which 66 have been classified as Cannabinoids, chemicals unique to the plant. The most well known and researched of these, delta-9-Tetrahydrocannabinol (Δ9-THC), is the substance primarily responsible for the psychoactive effects of cannabis.

The Cannabinoids are separated into subclasses. These are as follows:

- Cannabigerols (CBG)
- Cannabichromenes (CBC)
- Cannabidiols (CBD)
- Tetrahydrocannabinols (THC)
- Cannabinol (CBN) and cannabinodiol (CBDL)
- Other cannabinoids (such as cannabicyclol (CBL), cannabielsoin (CBE), cannabitriol (CBT) and other miscellaneous types).

Like opiates (substances derived from the opium poppy such as heroin), Cannabinoids affect the user by interacting with specific receptors, located within different parts of the central nervous system. Two kinds of Cannabinoid receptors have been found to date and are termed CB1 and CB2. A substance that occurs naturally within the brain and binds to CB1 receptors was discovered in 1992 called Anandamine. Additional naturally occurring substances that bind to CB1 have since been discovered, and these, together with the receptors are termed the Endogenous Cannabinoid System.

The actual effects that the cannabinoids have reflect the areas of the brain they interact with. Interactions tend to occur in our limbic system (the part of the brain that affects memory, cognition and psychomotor performance) and meso-limbic pathway (activity in this region is associated with feelings of reward) and are also widely distributed in areas of pain perception.

We are still learning about the endogenous cannabinoid system. Much of the research however, has focused on the many potential medical uses of man-made cannabinoids, called "synthetic analogues."

The major differences between the Cannabinoids are determined by the extent to which they are psychologically active. Three classes of Cannabinoids, the CBG, CBC and CBD are not known to have such an effect. THC, CBN, CBDL and some other Cannabinoids on the other hand are known to be psychologically active to varying degrees.

CBD is probably the most abundant Cannabinoid, contributing up to 40% of cannabis resin. Interestingly, CBD may actually have anti-anxiety effects and lessen the psychoactive effects of THC. This means that a plant with a greater percentage of CBD may reduce the intensity of the effects of the THC, which in effect lowers the potency of the plant. Use of a cannabis plant with less CBD has been shown to have an increased psychological impact and result in unwanted effects such as anxiety.

When THC is exposed to air it oxidizes and forms CBN. CBN is only very weakly psychoactive and not unlike CBD interacts with THC to reduce its effects. This is why cannabis that has been left out unused will have increasing amounts of CBN and decreasing amounts of THC and thus lose potency.

Note on Terpenes Profile in Cannabis sativa products.

Terpenes are common constituents of flavourings and fragrances. Terpenes, unlike cannabinoids, are responsible for the aroma of cannabis. The FDA and other agencies have generally recognized terpenes as “safe.” Terpenes act on receptors and neurotransmitters; they are prone to combine with or dissolve in lipids or fats; they act as serotonin uptake inhibitors (similar to antidepressants like Prozac); they enhance norepinephrine activity (similar to tricyclic antidepressants like Elavil); they increase dopamine activity; and they augment GABA (the “downer” neurotransmitter that counters glutamate, the “upper”).

The typical scent of Cannabis results from about 140 different terpenoids. Iso-prene units (C5H8) form Monoterpenoids (C10 skeleton),Sesquiterpenoids (C15),Diterpenoids (C20), and Triterpenoids (C30). Terpenoids may be acyclic,monocyclic, or polycyclic hydrocarbons with substitution patterns including alcohols,ethers, aldehydes, ketones, and esters. The essential oil (volatile oil) can easily be obtained by steam distillation or vaporization. The yield depends on the Cannabistype (drug, fiber) and pollination; sex, age, and part of the plant; cultivation (indoor,outdoor etc.); harvest time and conditions; drying; and storage. Of 57 identified constituents 92% are monoterpenes, 7% sesquiterpenes, and approx 1% other compounds (ketones, esters). The dominating monoterpenes are myrcene (67%) and limonene (16%). In the essential oil from outdoor-grown Cannabis, the monoterpene concentration varies between 47.9 and 92.1% of the total terpenoid content. The sesquiterpenes range from 5.2 to 48.6%. The most abundant monoterpene is E-myrcene, followed by trans-Caryophyllene, D-pinene, trans-ocimene, and D-terpinolene. In th eessential oil of five different European Cannabis cultivars, the dominating terpenes aree myrcene (21.1–35.0%), D-pinene (7.2–14.6%), D-terpinolene (7.0–16.6%), trans-caryophyllene (12.2.–18.9%), and D-humulene (6.1–8.7%). The main differences between the cultivars are found in the contents of D-terpinolene and D-pinene. Other terpenoids present only in traces are sabinene, D-terpinene, 1,8-cineole (eucalyptol), pulegone, J-terpinene, terpineol-4-ol, bornyl acetate, D-copaene, viridiflorene, E-bisabolene, J-cadinene, trans-E-farnesene,t rans-nerolidol, and E-bisabolol.

Examples of Terpenes

Myrcene, specifically β-myrcene, is a monoterpene and the most common terpene produced by cannabis. Its aroma has been described as musky, earthy, herbal – akin to cloves. Myrcene is found in oil of hops, citrus fruits, bay leaves, eucalyptus, wild thyme, lemon grass and many other plants. Myrcene is a potent analgesic, anti-inflammatory, antibiotic and antimutagenic. It blocks the action of cytochrome, aflatoxin B and other pro-mutagenic carcinogens.

Pinene is a bicyclic mono-terpenoid. Akin to its name, pinene has distinctive aromas of pine and fir. There are two structural isomers of pinene found in nature: α-pinene and β-pinene. Both forms are important components of pine resin. α-pinene is the most widely encountered terpenoid in nature. Pinene is found in many other conifers, as well as in non-coniferous plants. It is found mostly in balsamic resin, pine woods and some citrus fruits. Pinene is used in medicine as an anti-inflammatory, expectorant, bronchodilator and local antiseptic. α-pinene is a natural compound isolated from pine needle oil which has shown anti-cancer activity.

Limonene is a monocyclic mono-terpenoid and one of two major compounds formed from pinene. As the name suggests, varieties high in limonene have strong citrusy smells like oranges, lemons and limes. Strains high in limonene promote a general uplift in mood and attitude. Limonene is highly absorbed by inhalation and quickly appears in the bloodstream. It assists in the absorption of other terpenes through the skin and other body tissue. It is well documented that limonene suppresses the growth of many species of fungi and bacteria, making it an ideal antifungal agent for ailments such as toenail fungus. Limonene may be beneficial in protecting against various cancers, and orally administered limonene is currently undergoing clinical trials in the treatment of breast cancer. Limonene has been found to even help promote weight-loss.

Note on Terpenes Profile in Cannabis sativa products.

Beta-caryophyllene is a sesquiterpene found in many plants such as Thai basils, cloves, cinnamon leaves and black pepper, and in minor quantities in lavender. It's aroma has been described as peppery, woody and/or spicy. Caryophyllene is the only terpene known to interact with the endocannabinoid system (CB2). Studies show β–caryophyllene holds promise in cancer treatment plans. Research shows shows that β–caryophyllene selectively binds to the CB2 receptor and that it is a functional CB2 agonist. Further, β–caryophyllene was identified as a functional non-psychoactive CB2 receptor ligand in foodstuff and as a macrocyclic anti-inflammatory cannabinoid in cannabis.

Linalool is a non-cyclic mono-terpenoid and has been described as having floral and lavender undertones. Varieties high in linalool promote calming, relaxing effects. Linalool has been used for centuries as a sleep aid. Linalool lessens the anxious emotions provoked by pure THC, thus making it helpful in the treatment of both psychosis and anxiety. Studies also suggest that linalool boosts the immune system; can significantly reduce lung inflammation; and can restore cognitive and emotional function (making it useful in the treatment of Alzheimer's disease).

Terpinolene is a common component of sage and rosemary and is found in the oil derived from Monterey cypress. Its largest use in the United States is in soaps and perfumes. It is also a great insect repellent. Terpinolene is known to have a piney aroma with slight herbal and floral nuances. It tends to have a sweet flavor reminiscent of citrus fruits like oranges and lemons. Terpinolene has been found to be a central nervous system depressant used to induce drowsiness or sleep or to reduce psychological excitement or anxiety. Further, terpinolene was found to markedly reduce the protein expression of AKT1 in K562 cells and inhibited cell proliferation involved in a variety of human cancers.

Camphene, a plant-derived mono-terpene, emits pungent odours of damp woodlands and fir needles. Camphene may play a critical role in cardiovascular disease. Studies have fund camphene reduces plasma cholesterol and triglycerides in hyperlipidemic rats. Given the importance that the control of hyperlipidemia plays in heart disease, the results of this study provide insight into to how camphene might be used as an alternative to pharmaceutical lipid lowering agents which are proven to cause intestinal problems, liver damage and muscle inflammation. This finding alone warrants further investigation.

Terpineol, terpinen-4-ol, and 4-terpineol are three closely related mono-terpenoids. The aroma of terpineol has been compared to lilacs and flower blossoms. Terpineol is often found in cannabis varieties that have high pinene levels, which unfortunately mask the fragrant aromas of terpineol. Terpineol, specifically α-terpineol, is known to have calming, relaxing effects. It also exhibits antibiotic, AChe inhibitor and antioxidant antimalarial properties.

Phellandrene is described as pepperminty, with a slight scent of citrus. Phellandrene is believed to have special medicinal values. It has been used in Traditional Chinese Medicine to treat digestive disorders. It is one of the main compounds in turmeric leaf oil, which is used to prevent and treat systemic fungal infections. Phellandrene is perhaps the easiest terpene to identify in the lab. When a solution of phellandrene in a solvent (or an oil containing phellandrene) is treated with a concentrated solution of sodium nitrate and then with a few drops of glacial acetic acid, very large crystals of phellandrene nitrate speedily form.

Humulene is a sesquiterpene also known as α-humulene and α–caryophyllene; an isomer of β–caryophyllene. Humulene is found in hops, cannabis sativa strains, and Vietnamese coriander, among other naturally occurring substances. Humulene is what gives beer its distinct 'hoppy' aroma. Humulene is considered to be anti-tumor, anti-bacterial, anti-inflammatory, and anorectic (suppresses appetite). It has commonly been blended with β–caryophyllene and used as a major remedy for inflammation. Humulene has been used for generations in Chinese medicine. It aids in weight loss by acting as an appetite suppressant.

Part H – Product Quality Chemical Analysis

Method of Analysis: Accelerated Shelf-Life Analysis using ComBase Software.

SHELF-LIFE TESTING PROGRAMME

Shelf Life Testing was performed to test the Bacterial and Chemical integrity of the finished product. Demonstrating both the absence of Pathogenic bacteria and Rancidity conditions in the product are the safest ways of avoiding consumer cases of illness. The finished report may be used as an excellent sales tool as it indicates that the product is shelf stable and free of Pathogenic bacteria for the estimated time.

TESTING REGIME

An initial sample was tested for the following Microbiological Series when the samples were first received. After Microbiological Analysis, the sample was dispatched to the Chemistry Laboratory, where it underwent a series of Chemical Rancidity tests, as well as a suite of Physical and Sensory assessments. The remaining samples underwent the same testing regime at agreed time points and the testing programme continued until the product reached the end of its Shelf-Life.

Microbiological	Chemical	Physical	Sensory
Total Aerobic Count @ 22^{o} C	*Hydroxyl Value*	*Water Activity*	*Smell*
Total Aerobic Count @ 37^{o} C	*Peroxide Value*	*pH Value*	*Taste*
Esch. Coli	*Free Fatty Acid*	*Conductivity*	*Texture*
Salmonella spp.	*TBA Rancidity*		*Colour*
Enterobacteriaceae	*TOTOX Value*		
Coagulase (+) Staphylococcus			
Listeria Monocytogenes			
Clostridium Perfringens			
Campylobacter spp.			
Pseudomonas spp.			

SHELF-LIFE TEST CONDITIONS

METHODOLOGY:	Shelf-Life (Ambient)
DATE OF COMMENCEMENT OF TESTING:	9th. March 2020
DATE OF CONCLUSION OF TESTING:	23rd. March 2020
DATE OF REPORT:	23rd. March 2020
DATA ANALYSIS:	EXCEL 2007 Spreadsheet
TEMPERATURE OF TESTING:	Ambient Temperature.
SAMPLE PREPARATION:	No Preparation.
SHELF-LIFE METHOD:	Micro/Rancidity/Chemical
DATE OF SAMPLE:	9th. March 2020
PRODUCT CODE:	Not Provided.

SHELF LIFE CERTIFICATE FOR

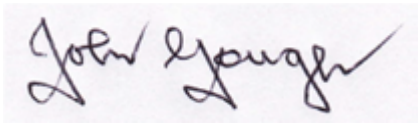
Holistic Hemp Scotland

CBD Massage Oil Spray

This is to certify that the Body Care product

'CBD Massage Oil Stray'

stored under recommended Ambient conditions and, if the packaging is unopened and undamaged, is guaranteed to have a Shelf-Life of 32 months from Date of Production.

Signed :___  _____ Technical Director

JHG Analytical Services Limited

Killowen

Waterford.

Dated : 23rd. March 2020

Assessment Conclusion

All test methods were performed in accordance with the requirements of ISO: IEC 17025.

The test results relate only to the product listed in this report.

Stability of product: This product complies with relevant legal regulations.

Based on the information derived, the Chemical/Microbiological shows the sample to be assessed as microbiologically safe and free of any forbidden hazardous Chemical components and contaminants.

Analytical Assessor

John Gough B.Sc. M.Sc.

Assessor Credentials

B.Sc (Hons) in Analytical Chemistry with Quality Management.

M.Sc in Environmental Chemistry.

Full Member of Royal Society of Chemistry (RSC).

Research Fellow at Trinity Biomedical Science Institute (Dublin).

J.W. GOUGH

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Technical Signatory. **Dated: 23rd. March 2020**