



Biological study and quality assessment of the oil obtained from seeds of *Cannabis sativa* L.

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ABSTRACT-Context: *Cannabis sativa* L. (Hemp) seeds have been widely acknowledged by various ethnic groups and traditional healers. **Objectives:** phytoconstituents and quality assessment of the oil. **Methods:** the oil of hemp seed was extracted by Soxhletion method using n-hexane as the solvent. The quality of oil was analyzed for specific gravity, refractive index, saponification value, iodine value, acid value, peroxide value, and oil color index along with oil pigment determination. GC-MS, TPC, TFC, antioxidant, antimicrobial activity were evaluated. **Results:** The iodine value, saponification value, acid value, peroxide value were calculated to be 133.217 g/100g of oil, 203.467 mg KOH/g of oil, 2.197 mg KOH/g of oil and 3.815 mEq/kg respectively. GC-MS analysis identified 14 compounds. The oil sample showed Total Phenolic Content of 131.347 mg GAE/g and Total Flavonoid Content of 38.786 mg QE/g. The percent free radical scavenging assay for hemp seed oil a IC₅₀ value of 8.162µg/ml. The hemp seed oil demonstrated no antibacterial activity against *E. coli* and *S. aureus*. **Conclusion:** The hemp seed oil showed the presence of phytoconstituent with pharmacological activity that validates the therapeutic potential of *Cannabis sativa* L.

Keywords: antibacterial, *Cannabis sativa* L., GC-MS

INTRODUCTION

Medicinal plants and plant-based medicines have long been utilized in traditional cultures globally, and their popularity is rising in contemporary society as natural alternatives or supplements to synthetic chemicals (Wyk & Wink, 2017). Medicinal plants are a major source of traditional medicines and play crucial roles in food supplements, nutraceuticals, pharmaceutical industries, and the creation of synthetic drugs. Natural products and their derivatives, including antibiotics, account for over 50% of all drugs used globally (Wyk & Wink, 2017). In Nepal, the diverse topography and climate have led to a rich variety of herbal plants (Crimaldi et al., 2017). The Department of Medicinal Plants' 1984 publication, "Medicinal Plants of Nepal," lists approximately 471 medicinal plant species, while the Nepalese Plant Database (NPD) identifies 1,624 medicinal plant species found in both cultivated and wild forms. (Crimaldi et al., 2017). *Cannabis sativa* L. (hemp), a flowering plant from the Cannabaceae family, is renowned for its broad range of uses in both traditional and contemporary medicine. In Nepal, *Cannabis* has been utilized for centuries due to its psychoactive, therapeutic, and spiritual significance. Locally referred to as "भाङ्ग" (Bhaang), "गाँजा" (Gaanja), and "चरेस" (Chares), depending on the form in which it is used, various parts of the plant have traditionally been employed in Ayurvedic medicine to alleviate pain, digestive issues, and respiratory conditions. Furthermore, *Cannabis* holds cultural importance in religious rituals, particularly during Hindu festivals like Shivaratri, where the consumption of *Bhaang* is viewed as sacred (Wyk & Wink, 2017). In Nepal, interest in hemp has surged over the past decade due to its diverse applications, including in food, textiles, cosmetics, and biochemicals. Hemp seed oil is particularly valued for its high-quality nutrients and versatile natural remedies. It serves as an edible oil rich in essential fatty acids, with about 80% content and an optimal omega-6 to omega-3 ratio (Crimaldi et al., 2017). The seeds themselves contain approximately 25% oil, 30% carbohydrates, 25% protein, 15% insoluble fiber, and are rich in phosphorus, carotene, magnesium, potassium, calcium, sulfur, zinc, and iron, as well as vitamins C, E, B₁, B₂, B₃, as well as B₆. Hemp seeds are a leading source of essential fatty acids, featuring an ideal 3:1 ratio of omega-3 linolenic acid to omega-6 linoleic acid, which supports immune system function (Leger, 2000). The seeds of *Cannabis sativa* L. have been a significant nutritional resource for thousands of years in Old World cultures (Callaway, 2004). Hemp seed oil is recognized for its positive effects on platelet aggregation and its role in treating or preventing cardiovascular diseases. It supports cardiovascular health by reducing the risk of sudden cardiac arrest, fatal arrhythmias, high blood cholesterol, and cellular proliferation associated with atherosclerosis (Leger, 2000). Additionally, it helps in addressing scaly skin conditions, inflammation, rheumatism, diabetes, itching, poor wound healing and excessive epidermal water loss, and is helpful for managing psoriasis and atopic eczema. Hempseed oil also contains notable levels of tocopherols, which have antioxidant properties. The presence of cannabidiol (CBD) in the oil is associated with anticonvulsant, anti-epileptic, and antimicrobial effects (Grotenhermen et al., 1998). Moreover, hempseed oil is a abundant source of gamma-linolenic acid (GLA), and its GLA and vitamin D content contribute to the prevention and management of osteoporosis. Traditionally, hemp seeds have been used as a remedy for tumors and cancerous ulcers. The oil is also used in paints, shampoos, and soaps, and is included in cosmetics and body care products due to its antimicrobial,

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anti-aging, and anti-inflammatory properties, as well as its ability to balance skin pH and moisture levels. Despite their potential benefits, traditional medicines often face issues related to unverified effectiveness, lack of standardization, absence of specific regulations, and inadequate herbal pharmacovigilance, which raises concerns about their safety and efficacy. There is an urgent need to review their effectiveness, establish proper processing methods, and regulate dosages to ensure drug efficacy and minimize toxicity. Additionally, it is crucial to ensure that the quality of hemp seed oil is optimal for its intended use. Therefore, efforts have been made to examine the phytochemical properties of the oil obtained from *Cannabis sativa* seeds, including GC-MS analysis, total flavonoid content (TFC), total phenolic content (TPC), and to study its pharmacological activities, including antioxidant and antimicrobial effects.

METHODS

Plant material: Seeds of *Cannabis sativa* L. were procured from a local market in the Kathmandu district, Bagmati zone, Nepal. These seeds were initially germinated in the laboratory at MMIHS, and a herbarium specimen of the germinated plant was created. The specimen was subsequently identified by Mr Subash Khatri, taxonomist, National Herbarium and Plant Laboratories (NHPL) in Godawari, Lalitpur, Nepal, and was assigned the voucher number 078/079/523.

Preparation of oil extract: The extraction of oil from the *Cannabis sativa* L. seeds was done using Soxhlet method. 30 grams of the powdered plant material was taken in a round bottom flask. The powder was extracted using 300 ml of n-hexane. The Soxhlet extraction was performed for the duration of 8 hours. After 8 hours, the extract was collected and then evaporated to obtain oil. The process was repeated until the desired amount of oil was obtained. The oil was then kept in amber colored bottles and stored at 4°C (Ameer et al., 2011).

$$\text{Extractive yield value (\%)} = \frac{\text{weight of oil}}{\text{weight of plant material taken}} \times 100$$

Evaluation of the oil: The obtained hemp seed oil was evaluated for its physical properties which include the physical state, colour, odour, taste, solubility, refractive index and specific gravity (20°C). The physical state, taste, odour and colour were assessed using sensory evaluation. The solubility and specific gravity (20°C) were performed in the Manmohan Memorial Institute of Health Sciences (MMIHS) laboratory. The oil sample was sent to Natural Products Research Laboratory, Thapathali, Kathmandu for the determination of refractive index.

Quality assessment of the oil: The quality assessment was performed for the hemp seed oil by determination of saponification value, acid value, iodine value, peroxide value, oil color index and oil pigment ratio. The acid value, saponification value, peroxide value, and iodine value were measured following the standard methods established by the Association of Official Agricultural Chemists (AOAC).

Acid value: The acid value was determined using the standard method of AOAC 940.28 and ISO 660.2009. Procedure involved the preparation of 0.1N KOH, phenolphthalein

indicator solution and sample. The acid value was determined using the following formula:

$$\text{Acid value} = \frac{\text{MW} \times \text{N} \times \text{V}}{\text{Weight of sample}}$$

where, MW is the molecular weight of KOH, N is the normality of KOH and V is the volume consumed of KOH.

Saponification value: The saponification value was determined according to the standard method of AOAC 920.160. Procedure involved the preparation of 4% ethanolic KOH, preparation of 0.5N HCl and preparation of phenolphthalein indicator solution which was followed by the preparation of sample and blank preparation (AOAC, 2005). The saponification value was determined using the following equation:

$$\text{Saponification value} = \frac{28.05 \times (\text{V}_2 - \text{V}_1)}{\text{Weight of sample}}$$

where, V_2 is the volume consumed by blank and V_1 is the volume consumed by sample.

Peroxide value: The peroxide value of the hemp seed oil samples was assessed using the method outlined in AOAC 965.33. Procedure involved the preparation of 1% starch solution, 0.01N sodium thiosulphate, solution of 15% potassium iodide, potassium dichromate solution followed by the preparation of sample (AOAC, 2005). Peroxide value can be determined using the given formula:

$$\text{Peroxide value} = \frac{1000 \times \text{N} \times (\text{V}_2 - \text{V}_1)}{\text{Weight of sample}}$$

where, N is the normality and V is the volume consumed.

Iodine value: The iodine value was determined using the standard method of AOAC 920.159. Procedure involved the preparation of 1% starch solution, 0.1N sodium thiosulphate, 15% potassium iodide solution, potassium dichromate solution followed by the preparation of sample and blank (AOAC, 2005). The iodine value was determined using the following equation:

$$\text{Iodine value} = \frac{12.69 \times \text{N} \times (\text{V}^2 - \text{V}^1)}{\text{Weight of sample}}$$

where, V_2 is the volume consumed by blank and V_1 is the volume consumed by sample

Oil color index: It was assessed based on the method reported by Moghimi et al., 2018 (Esmaeilzadeh Kenari & Dehghan, 2020). The color of oil was evaluated using a spectrophotometric technique, measuring light absorbance at wavelengths of 460,

550, 620, and 670 nm. The color index was subsequently determined using the following equation:

$$\text{Color index} = 1.29A_{460} + 69.7 A_{550} + 41.2 A_{620} - 56.4 A_{670}$$

Oil pigment determination: The chlorophyll and carotenoid content of the hemp seed oil samples was assessed using the method described by Isabel Minguez-Mosquera et al., with slight modifications as outlined by Izzo et al. (2020). The pigment content in the oil ($\mu\text{g/ml}$) was determined using the following formula:

$$\begin{aligned} \text{Chlorophyll a} &= 9.93 * A_{663} - 0.78 * A_{640} \\ \text{Chlorophyll b} &= 17.60 * A_{640} - 2.81 * A_{663} \\ \text{Chlorophyll a + b} &= 7.12 * A_{663} + 16.80 * A_{640} \\ \text{Total carotene} &= \frac{(1000 * A_{470} - 0.52 * \text{Chl a} - 7.25 * \text{Chl b})}{226} \end{aligned}$$

GC-MS analysis: The GC-MS analysis was performed at the Nepal Academy of Science and Technology (NAST) in Khumaltar, Lalitpur.

Determination of Total Phenolic Content: For the determination of the Total Phenolic Content (TPC) of the hemp seed oil, polyphenols and fatty acids were first extracted from the sample. The extracted sample was then tested for TPC using the Folin-Ciocalteu method. Polyphenols were extracted following the procedure outlined by Moccia et al., with minor modifications (Moccia et al., 2019). The TPC was measured using the Folin-Ciocalteu method, and the results were expressed as milligrams of Gallic Acid Equivalents (GAE) per gram of sample.

Determination of total flavonoid content: The Total Flavonoid Content was performed in accordance to the procedure reported by Sultana et al., with slight modification (Ghimera et al., 2014). The TFC values were measured using a calibration curve created with a range of Quercetin standards (10-200 $\mu\text{g/ml}$) and the TFC was reported as milligrams of Quercetin Equivalents (QE) per gram of sample (mg QE/g).

DPPH radical scavenging activity: The free radical scavenging activity of the oil was evaluated based on its ability to scavenge the stable 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical, using ascorbic acid as the standard, according to the method reported by Zaha Elagbar et al. (Zaha et al., 2016). The residual DPPH free radical activity against a blank was measured at 517 nm using the following formula:

$$\text{DPPH radical scavenging activity} = \left(\frac{A^{517}\text{blank} - A^{517}\text{sample}}{A^{517}\text{blank}} \right) \times 100\%$$

The percentage of scavenging was plotted against concentration to obtain a regression equation. The IC_{50} values, which indicate the microgram concentration needed to inhibit DPPH radical formation by 50%, were calculated for each plant extract using this inhibition curve. A lower absorbance of the reaction mixture indicates greater free radical scavenging activity.

Antibacterial activity: The antimicrobial activity against *Staphylococcus aureus* and *Escherichia coli* was evaluated by cup plate agar diffusion method in accordance to the method reported by Esra et al. (Esra et al., 2012) with slight modifications and also with the method reported by Doughari et al.

RESULT AND DISCUSSION

Extractive value: After the extraction of oil and complete evaporation of the solvent, the weight of the oil and the weight of the dried plant material were measured. The extractive value of oil extracted from the seeds of *Cannabis sativa* L. using n-hexane as solvent was found to be 37.26%. According to the research performed by Jose Alonso-Esteban et al., the extractive value for hemp seed oil using n-hexane as solvent was found to be 34.60% (Jose et al., 2020). The extractive value of the sample was found to be 37.26% which is slightly greater than the above reported value.

Evaluation of the hemp seed oil: The physical state of the hemp seed oil was determined to be liquid with green colour and pleasant nutty odour and bland taste. The specific gravity and refractive index were determined to be 0.9627 and 1.4775 at 20°C respectively. According to the research performed by Shobha S. Borhade, the refractive index and specific gravity was found to be 1.4570 and 0.8927 respectively. The results for the physical properties were found to be similar with the research performed by Shobha S. Borhade (Borhade, 2013). The slight differences in the refractive index and specific gravity may be due to geographical variations as well as difference in time of soxhlet extraction.

Quality assessment of the hemp seed oil: The acid value, saponification value, peroxide value and iodine value were determined to be 2.197 ± 0.03 mg KOH/g of fat, 203.467 ± 1.46 mg KOH/g of oil, 3.815 ± 0.44 Meg/kg and 133.217 ± 1.87 g/100 g of oil respectively. The oil colour index was determined to be 52.693. Likewise, the oil pigment ratio was determined to be 3.02 with total carotene value of 0.676 ± 0.00 and chlorophyll a + b value of 2.044 ± 0.02 . The result obtained from the sample oil was quite similar to the research performed by Shobha S. Borhade and the slight differences may be due to geographical variation, variation in time of Soxhlet extraction and collection time. The oil pigment ratio was determined to be 3.02 which fall in the range of 2.5 to 3.7 mg total chlorophyll/total Carotenoid (Izzo et al., 2020). According to the research performed by Reza et al., the oil color index was determined for 15 different oil samples, which were found to be in the range of -0.8 to 49.4 which is similar to the value of the sample oil. The difference may be due to the difference in geographical conditions as well as the use of different solvent for the extraction of oil (Esmaeilzadeh Kenari & Dehghan, 2020).

GC-MS analysis of hemp seed oil: GC-MS analysis of oil obtained from the seeds of *Cannabis sativa* L. led to the resolution of 14 compounds (Table 1).

Table 1: GC-MS analysis compounds

S.N.	Library/ID	Retention time	Area (%)	Mass (g/mol)
1.	Cyclohexane	2.4429	26.0439	84.16

2.	Oxirane, heptadecyl-	58.4036	22.7184	254.40
3.	9,12-Octadecadienoic acid (Z,Z)-	41.4007	12.4265	280.45
4.	9,12-Octadecadienoic acid (Z,Z)-	41.3036	11.8854	280.45
5.	Heptadecane	51.2507	4.8387	240.43
6.	N-hexadecanoic acid	38.0994	3.6931	256.42
7.	2,6,10-Dodecatrien-1-ol,3,7,11-trimethyl-	57.5621	3.076	204.34
8.	2-chloropropionic acid, octadecyl ester	51.0026	2.9231	352.90
9.	Gingerol	39.4695	2.4356	345.40
10.	Resorcinol, 2-p-mentha-1,8-dien-3-yl-5-pentyl,-(-)-(E)-	46.3743	2.3271	318.44
11.	Gingerol	38.8006	2.1388	345.40
12.	Benzenethamine, 5-methoxy-N-[[3,5-dimethoxyphenyl]acetyl]-	55.2857	2.0587	281.32
13.	Dronabiol	48.5859	1.9838	314.47
14.	Trans-1-butyl-2-methylcyclopropane	2.1408	1.451	138.22

The GC-MS analysis of the hemp seed oil demonstrated the highest index of cyclohexane with area (%) of 26.0439 followed by oxirane with 22.7184% and linoleic acid with 12.4265%. (Annex III) The highest index of cyclohexane may be because the sample oil was unrefined.

Determination of TPC and TFC: The total phenolic content (TPC) of the oil sample was determined using the Folin-Ciocalteu method and reported as gallic acid equivalents (GAE) (Figure 1 and 2). The concentration of phenolics in the oil was calculated from the calibration curve, with the regression equation $Y = 0.0049X + 0.1184$ and $R^2 = 0.9988$. The calibration curve was constructed using absorbance values obtained at various concentrations of gallic acid. Moccia et al. (2019) reported TPC values for 13 oil samples ranging from 22.1 to 160.8 mg GAE/g of oil, indicating that factors such as cultivar and geographical location can significantly influence the total phenolic content. The total flavonoid content (TFC) of the oil sample was determined using a colorimetric assay with aluminum chloride and reported as Quercetin equivalents (QE). The flavonoids concentration in the oil was calculated from the calibration curve, with the regression equation $Y = 0.0112X - 0.1374$ and $R^2 = 0.996$. The calibration curve was constructed using absorbance values obtained at various concentrations of quercetin. According to the research performed by Hye Lim Jang et al. (Hye Lim et al., 2018), the total flavonoid content was determined to be 39.15 mg QE/g which is similar to the result of the analyzed oil (Figure 1).

DPPH assay: The oil sample showed a percentage inhibition of 16.714 at 5 µg/ml and 60.623 at 25µg/ml while the ascorbic acid showed a percentage inhibition of 2.408 at 5 µg/ml and 47.451 at 25 µg/ml (Figure 3). The IC_{50} value for ascorbic acid was determined to be 15.142 µg/ml, while the IC_{50} value for the oil sample was 8.162 µg/ml. A lower IC_{50} value indicates a higher scavenging ability. The oil sample showed greater antioxidant activity than the ascorbic acid, which may be because ascorbic acid was only fairly soluble in n-hexane which may have hindered the % RSA activity. The study revealed that the oil sample showed profound antioxidant activity.

Antibacterial activity: The oil showed no antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*. However, a previous study by Leizer et al. observed some bioactivity in hemp seed oil during primary screening (Cary et al., 2015). According to the research performed by Veronika Mikulcova et al., the results for the antibacterial activity of the oil sample showed weak activity against *Staphylococcus aureus* with inhibition zone ranging from 0.3 to 3.3 mm and the oil showed no activity against *Escherichia coli*. According to the research performed by Esra et al., (2012), the cold pressed oil of hemp seed exerted pronounced activity against *S. aureus* (21-28mm) and *E. coli* (16mm). The absence of antimicrobial activity may be because of the use of n-hexane as solvent for the extraction of oil as well as the geographical variations.

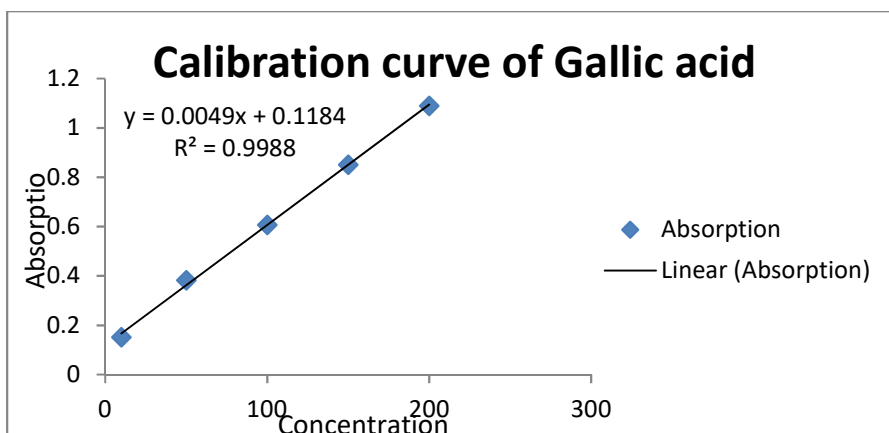


Figure 1: Calibration curve of gallic acid

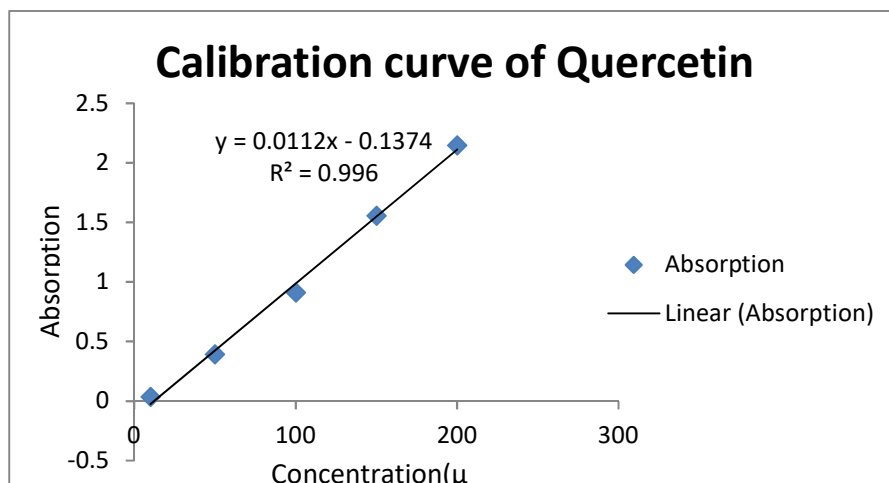


Figure 2: Calibration curve of quercetin

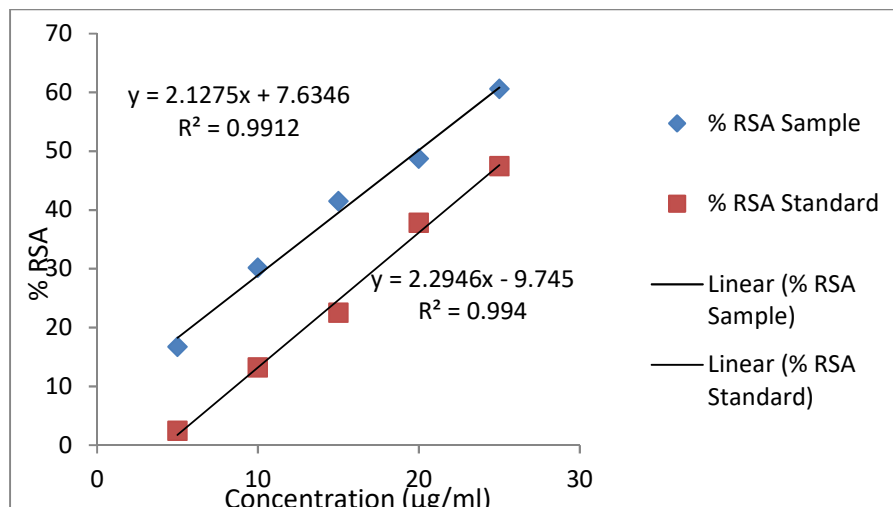


Figure 3: Antioxidant activity by DPPH method

CONCLUSION

The present study on the hemp seed oil obtained from n-hexane demonstrated quality assessment values which were within local limit range, concluding the oil to be of optimum quality with minimum rancidity. The oil has antioxidant property.

ACKNOWLEDGMENT

The authors express their gratitude to Manmohan Memorial Institute of Health Sciences management for providing laboratory facilities. The plant material identification was carried out by the National Herbarium and Plant Laboratories, Godawari, Lalitpur, Nepal. GC-MS analysis was conducted at the Nepal Academy of Science and Technology (NAST), Khumaltar, Lalitpur. Their assistance is sincerely appreciated.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF HONOR

We declare, on our honor, that the results presented are accurate and not fabricated.

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प्राविधिक विशेषज्ञको प्रतिवेदन

१. नमूना परीक्षण गर्ने पठाउने व्यक्ति/निकास:- श्री Manmohan Memorial Institute of Health Sciences
सोल्टिमोड, काठमाडौं।
- १(क) विद्यार्थीहरूको नाम:- Ms. Ritika Shakya
२. प्राप्त नमूनाको विवरण:- हर्बेरियमको नमूना १ थान।
३. यस कार्यालयमा प्राप्त मिति:- २०७८/०९/२०
४. परीक्षणका आधारहरू:- (क) हर्बेरियममा भएको नमूनाहरू संगको तुलनात्मक अध्ययन ।
(ख) सन्दर्भ सामग्रीहरूको अध्ययन ।
५. पहिचान प्रतिवेदन:- प्राप्त नमूनाको Morphological अध्ययन र यस राष्ट्रिय हर्बेरियम तथा बनस्पति प्रयोगशालाको हर्बेरियममा राखिएका नमूनाहरू संगको तुलनात्मक अध्ययन गर्दा उक्त नमूना Cannabaceae बनस्पति परिवारको *Cannabis sativa* L. प्रमाणित हुन गएको ।
६. परीक्षण गर्ने अधिकारी:-
हेम राज पौडेल
अनुसन्धान अधिकृत
(१८२५६९)

ANNEX II: Refractive Index Determination



Government of Nepal
Ministry of Forests & Environment
Department of Plant Resources
Natural Products Research Laboratory
Thapathali, Kathmandu
Ph no.: +977-01- 4268247/4266856
Web: www.nprl.gov.np


Rf No: 486/078/79

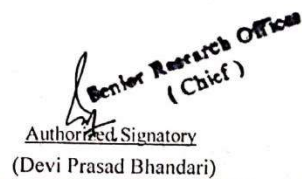
Analytical Report

Issued To: Manmohan Memorial Institute of Health Sciences Sample Type: Liquid
Sample Name: Cannabias oil Sample ID: 449
Sampled By: Customer Sample Received Date: 2079/01/21
Quantity of Sample received: 5 ml Analysis Started Date: 2079/01/21
Report No.: 470 Analysis Completion Date: 2079/01/23
Report Issued Date: 2079/02/24

Test Method for Refractive Index: ISO 280: 1998 (E)

S.N.	Parameters	Results
3.	Refractive Index	1.47748 @ 20.00°C

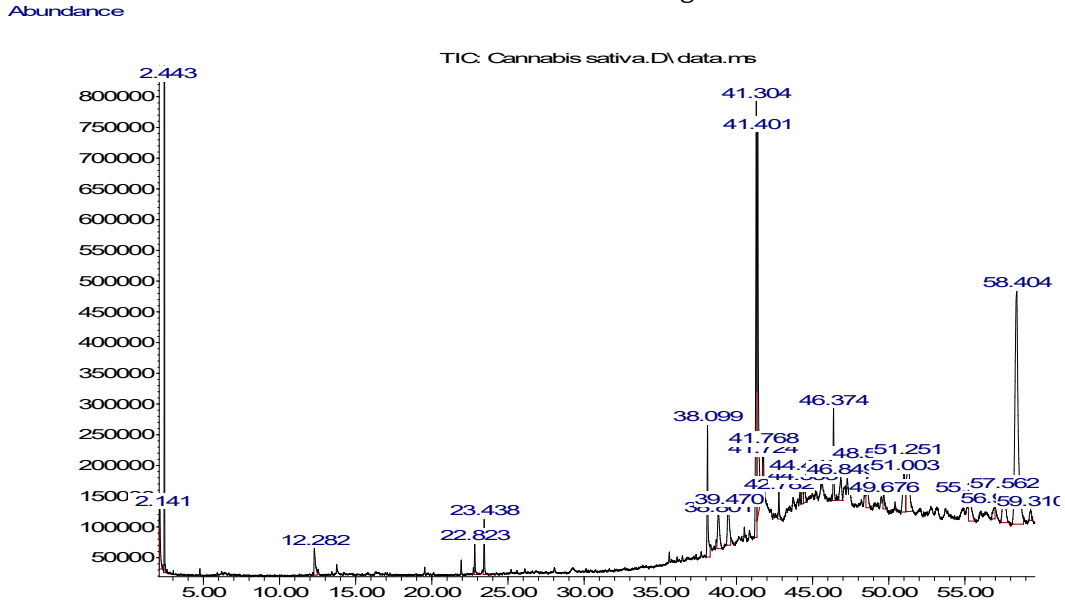

Checked By


Senior Research Officer
(Chief)
Authorized Signatory
(Devi Prasad Bhandari)

Note: 1. The above results refer only to the submitted sample and test performed.
2. This report cannot be used for any publicity or advertisement without the written consent of this laboratory.
3. Test report shall not be reproduced in full, without written approval of the laboratory.

DPR/OR/7.8/01

ANNEX III: GC-MS Chromatogram



Time-->

[contents]

count=1

Name= C:\msdchem\1\data\Shyaula\20790129\Cannabis sativa.D

1= PBM Apex

[PBM Apex]

Time= Fri Jun 03 11:08:55 2022

Header=	PK	RT	Area Pct	Library/ID	Ref	CAS	Qual
1=	1	2.1408	1.451	trans-1-Butyl-2-methylcyclopropane	6749	038851-70-6	49
2=	2	2.4429	26.0439	Cyclohexane	1449	000110-82-7	95
3=	3	38.0994	3.6931	n-Hexadecanoic acid	102725	000057-10-3	99
4=	4	38.8006	2.1388	Gingerol	132026	023513-14-6	87
5=	5	39.4695	2.4356	Gingerol	132026	023513-14-6	90
6=	6	41.3036	11.8854	9,12-Octadecadienoic acid (Z,Z)-	121228	000060-33-3	99
7=	7	41.4007	12.4265	9,12-Octadecadienoic acid (Z,Z)-	121228	000060-33-3	97
8=	8	46.3743	2.3271	Resorcinol, 2-p-mentha-1,8-dien-3-yl-5-pentyl-, (-)-(E)-	147577	000521-37-9	98
9=	9	48.5859	1.9838	Dronabinol	147526	001972-08-3	99
10=	10	51.0026	2.9231	2-Chloropropionic acid, octadecyl ester	177413	088104-31-8	95
11=	11	51.2507	4.8387	Heptadecane	90417	000629-78-7	91
12=	12	55.2857	2.0587	Benzeneethanamine, 5-methoxy-N-[[3,5-dimethoxyphenyl]acetyl]-	158015	1000117-06-5	83
13=	13	57.5621	3.076	2,6,10-Dodecatrien-1-ol, 3,7,11-trimethyl-	76501	004602-84-0	86
14=	14	58.4036	22.7184	Oxirane, heptadecyl-	122903	067860-04-2	96