

SURVEY OF LOW-THC HEMP SEED FOODS – Stage 2

July 2022

Conducted under the Implementation Subcommittee for Food Regulation (ISFR) Coordinated Food Survey Plan

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- Department of Health and Human Services Victoria,
- Queensland Health,
- South Australia Health,
- Western Australia Health,
- New Zealand Ministry of Primary Industries, and
- Food Standards Australia New Zealand.

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Glossary

CBD – cannabidiol. A chemical compound found in *Cannabis sativa* plant but it does not have a psychoactive effect.

ISFR – Implementation Sub Committee for Food Regulation

FRSC – Food Regulation Standing Committee of the Australia and New Zealand Ministerial Forum on Food Regulation

FSANZ – Food Standards Australia New Zealand

Hemp flour – Also known as hemp meal, hemp bran, hemp powder or hemp cake. It is made from raw hemp seeds after cold pressing to extract the hemp seed oil.

Hemp oil – It is made by cold pressing the hemp seeds.

Hemp protein – It is made from grinding the seeds of a hemp plant.

Hemp seed – Often referred as hemp hearts. It is the seed of the hemp plant, *Cannabis sativa*.

LOD – Limit of Detection

LOR – Limit of Reporting

MU – Measurement of Uncertainty of an analytical method

SEA WG – Surveillance, Evidence and Analysis Working Group

THC – tetrahydrocannabinol. The active component responsible for *Cannabis* psychotropic effects.

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Executive Summary

The term “hemp” refers to *Cannabis sativa* cultivars grown for industrial purposes. It is characterised by low levels of tetrahydrocannabinol (THC), the active component responsible for *Cannabis* psychotropic effects. The Australia New Zealand Food Standards Code (the Code) was amended in May 2017 to permit low-THC *Cannabis sativa* (hemp) seed as a food, effective from November 2017. Conditions around the sale of these foods include restrictions on labelling, seed viability, and levels of tetrahydrocannabinol (THC) and cannabidiol (CBD).

The Implementation Subcommittee for Food Regulation (ISFR) Surveillance, Evidence and Analysis Working Group (SEA WG) were tasked with conducting coordinated surveillance and intelligence gathering activities to assess compliance of low-THC hemp seed foods as a post-implementation measure.

In 2019 and 2021, a total of 201 hemp-based food samples were tested for the concentration of total THC and CBD. Products tested include hemp seeds, hemp flour, hemp protein, hemp oil, and other food products which contain hemp as an ingredient. Five samples of hemp seed oil were found to have levels of total THC above the limit of 10 mg/kg prescribed in the Code (ranged from 10.2 to 13.0 mg/kg). One hemp seed product and two hemp protein products were found to have levels of total THC above the limit of 5mg/kg (ranged from 5.2 to 6.0 mg/kg). All other samples tested were below the total THC limits set out in the Code. In addition, all products were below the limit sets out in the Code for CBD.

However, less than half of the product labels complied with the Code. The most common non-compliance was observed for the requirements around nutrition information and unsubstantiated nutritional or health claims.

Lastly, all non-compliances were followed up by each jurisdiction in accordance with the Australia and New Zealand Food Regulation Compliance, Monitoring and Enforcement Strategy.

Introduction

The term “hemp” refers to *Cannabis sativa* cultivars grown for industrial purposes. It is characterised by low levels of tetrahydrocannabinol (THC), the active component responsible for *Cannabis* psychotropic effects. The largest hemp seed producing nations are France and China, with substantial hemp industries also in Canada and parts of Europe. Hemp may be cultivated for seeds or fibre, but generally not simultaneously. Due to the regulatory environment, hemp is specifically grown in Australia for food or other industrial purposes such as fibre for clothing, ropes etc. Commercial or trial hemp crops are grown in all states in Australia under strict licensing conditions, with most commercial production in Tasmania (Agrifutures Australia, 2017; Industrial Hemp Taskforce Victoria, 2020).

On 11 May 2017 Food Standards Australia New Zealand (FSANZ) gazetted a variation to the *Australia New Zealand Food Standards Code* (the Code) – *Standard 1.4.4 Prohibited and Restricted Plants and Fungi* to allow low delta-9 tetrahydrocannabinol (THC) hemp seeds and seed products to be sold as food. These changes commenced on 12 November 2017 in Australia and 12 November 2018 in New Zealand.

Standard 1.4.4 provides an exemption to a prohibition of *Cannabis sativa* in food by permitting the retail sale of food products produced from the seeds of *Cannabis sativa* plants that do not contain more than 1% THC in the leaves and flowering heads (referred to as low-THC hemp throughout this report).

Permitted food products produced from low-THC hemp seed include: hulled non-viable seeds, oil, beverages, and any other product that is extracted or derived from hemp seeds. The Standard specifies various maximum levels of THC that may be present in these products as well as a 75 mg/kg maximum concentration of cannabidiol (CBD). There are also restrictions on claims and representations about foods that are, or which contain, hemp food products. These include prohibitions on: claims of psychoactive effects (expressed or implied), health and nutrition content claims about CBD, the use of images of *Cannabis sativa* plants (other than seeds), and the use of the words ‘cannabis’, ‘marijuana’ or words of similar meaning.

After the Code amendment in November 2017, the Food Regulation Standing Committee (FRSC) of the Australia and New Zealand Ministerial Forum on Food Regulation established a working group specifically to monitor the implementation of the revised Code across Australia and New Zealand. The working group identified a need for a coordinated surveillance, monitoring and intelligence gathering activity to understand the current compliance of hemp seed food products available for sale in Australia and New Zealand, and to respond to any non-compliances identified.

This project was carried out by the Surveillance, Evidence and Analysis Working Group (SEA WG) on behalf of ISFR. The project is intended to support the broader activities of FRSC in monitoring implementation of the revised Code. The results will also be used to provide advice to the food regulation system about the implementation of the relevant aspects of the Code and inform consideration of any further risk management actions.

Materials and Methods

The project was carried out in two stages:

Stage 1: An intelligence gathering exercise to consolidate information on existing activities and controls across Australia and New Zealand through questionnaires sent to industry, regulators and laboratories. Stage 1 was completed in 2020.

Stage 2: Targeted retail product examination and testing based on intelligence gathered during Stage 1. This stage aimed to collect data on the levels of THC and CBD found in hemp food products sold in Australia and New Zealand and assess their compliance to the Code.

Other work including the screening of imported foods for THC and CBD levels and visual examination of products (to confirm that seeds available for sale as food are hulled, and that all labelling is compliant) commenced as part of the Australian Government Department of Agriculture, Fisheries and Forestry Imported Food Inspection Scheme. This food is classified as surveillance food, with 5% of the tariff randomly tested.

This is a report of the results of Stage 2 activities.

Sample collection

In May to June 2019, 35 samples of pre-packaged low-THC hemp food products were purchased from a range of retailers in Victoria (VIC). These products were submitted to a laboratory for CBD and THC testing. Labelling assessment was conducted but no specific details are available, so these products are excluded from the labelling assessment section in this report. Six product labels were found to be non-compliant.

In May to December 2021, a further 166 samples were purchased in New South Wales (NSW), Queensland (QLD), South Australia (SA), Tasmania (TAS), Western Australia (WA), and New Zealand (NZ). Products were sent to laboratories for testing and the labels were assessed against Part 1.2 and Standard 1.4.4 of the Code. Each jurisdiction collected only products manufactured or imported in their jurisdictions. Samples were collected at random and not selected based on market share. As a result, samples were not fully representative of the bi-national purchasing trends or intake.

Sampling aimed to collect products with at least 60% low-THC hemp as the ingredients, for example hemp seed¹, hemp flour², hemp protein³ or hemp oil⁴. In addition, a small proportion of sampling aimed to collect products with hemp as part of the ingredients (with a minimum of 5% hemp), for example crackers, chocolates, spreads and breakfast cereals. Hemp products sold in capsule or tablet form or products that are not for human consumption were excluded from sampling. Products were stored as per the manufacturer's instruction until they were sent to laboratories for analysis.

¹ Often referred as hemp hearts. It is the seed of the hemp plant, *Cannabis sativa*.

² Also known as hemp meal, hemp bran, hemp powder or hemp cake. It is made from raw hemp seeds after cold pressing to extract the hemp seed oil.

³ It is made from grinding the seeds of a hemp plant.

⁴ It is made by cold pressing the hemp seeds.

Method of analysis

Testing was conducted by six laboratories using their in-house methods to determine the levels of total THC and CBD in the selected products.

Table 1. Testing methodology

Laboratory conducted the testing	Methodology
ACS Laboratories (Australia), Melbourne	<p>Total THC and total CBD was quantified using in-house methods based on AOAC Official Method 2018.11(Modified) and Waters Application Note UPLC Separation for the Analysis of Cannabinoids Content in Cannabis Flower and Extracts, 2019 (Catherine Layton and Andrew Aubin, Waters USA, Journal of Pharmaceutical and Biomedical Analysis - Analysis of cannabinoids in commercial hemp seed oil and decarboxylation kinetics studies of cannabidiolic acid (CBDA), 2017).</p> <p><i>Hemp Seeds / Flour / Proteins</i></p> <p>2 g of hemp seeds, flour or proteins powders were extracted in Ethanol (10 mL) by mechanical shaking and ultrasonication, followed by centrifugation. 1 mL of the extracts was analysed by RP UPLC-UV with QDA Mass Spectrometer, using 3–5-point external Calibration curve and Processed by Waters Empower 3 software.</p> <p>LOR: 0.2 ppm for seeds, 1 ppm for flour & protein. MU: ±30%.</p> <p><i>Hemp Seed Oils</i></p> <p>100 µl of hemp seed oils (weighed) was added to 100 µl THF + 300 µl ACCN and made to 2 mL (Vol Flask) with Ethanol. The mixture was shaken, filtered (0.22 µm PTFE) into HPLC vial and analysed by UPLC-UV-QDA MS using 3–5-point external Calibration curve and Processed by Waters Empower 3 software</p> <p>LOR: 0.2 ppm. MU: ±30%.</p> <p><i>Other Hemp Foods</i></p> <p>1 g of ground hemp food (weighed) was subjected to QuEChers extractions (Acidified ACCN) and clean-up filtered (0.22 µm PTFE) into HPLC Vial and analysed by UPLC-LCMSMS using 3-point external Calibration curve and Processed by Waters Mass Lynx Ver 4 software</p> <p>LOR: 0.2-0.5 ppm. MU: ±30%.</p>

Laboratory conducted the testing	Methodology
Analytical Services Tasmania, Hobart	<p>Total THC and total CBD were quantified using an in-house method based on Vaclavik et al. outlined in Journal of AOAC First Action 2018.11, with modifications.</p> <p>The sample was thoroughly mixed. A portion (0.1 g oil, 1 g other foods) was weighed into a 50 mL centrifuge tube and 10 mL of methanol was added. The sample was shaken/vortexed briefly and then placed on an end-over-end tumbler (whirly-gig) for 30 minutes before centrifuging. A portion of the extract was transferred (diluted as needed) to an autosampler vial for analysis.</p> <p>Analysis was done using an Agilent 1290 UPLC with C18 column and 6495 Triple-quadrupole mass spectrometer, using isotopically-labelled internal standards (CDB, THC) and a 6-point calibration curve created from ISO17034 accredited reference materials (Δ^9-THC, THCA, CBD, CBDA).</p> <p>Total THC and total CBD was calculated based on the following equation: Total THC = Δ^9-THC + (0.877*THCA). Total CBD = CBD + (0.877*CBDA).</p> <p>LOR for THC: 0.05 ppm. MU: $\pm 20\%$.</p> <p>LOR for CBD: 0.05 ppm. MU: $\pm 22\%$.</p>
Chem Centre, Perth	<p>Total THC and total CBD were determined using in-house method ORG175.</p> <p>Hemp seed samples were milled prior to extraction, while hemp powder was analysed as received. A known mass of sample was extracted in a known volume of LC-MS grade methanol. Extracts were analysed using liquid chromatograph mass spectrometry (LC-MS/MS) and quantified for Δ^9-Tetrahydrocannabinol (THC), Tetrahydrocannabinolic acid (THCA) and Cannabidiol (CBD) against calibration standards sourced from an ISO17034 supplier.</p> <p>Total THC was calculated based on the following equation: Total THC = Δ^9-THC + (0.877*THCA)</p> <p>LOR for Δ^9-THC: 4 ppm. MU: $\pm 9.2\%$</p> <p>LOR for THCA: 4 ppm. MU: $\pm 7.4\%$</p> <p>LOR for CBD: 4 ppm. MU: $\pm 10.8\%$</p>

Laboratory conducted the testing	Methodology
<p>National Measurement Institute, Melbourne</p>	<p>Total THC and total CBD were quantified using an in-house method.</p> <p><i>Food samples</i></p> <p>1 g of homogenous sample was mixed with water and acetonitrile, then extracted using a QuEChERS kit. Cannabinoids were separated by using a BEH C18 LC column. Detection was then made using a mass spectrometer system (LC-MS-MS) against a multi-point calibration of target analyte standards.</p> <p>LOR: 0.5 ppm. MU: ±20%.</p> <p><i>Oil samples</i></p> <p>Oil samples were dissolved in 2-propanol. The organic extracts were cleaned up by SPE, centrifuged then transferred to an LC vial. An internal standard solution was added before being analysed by using LC-MS-MS.</p> <p>LOR: 0.5 ppm. MU: ±20%.</p>
<p>Queensland Health Forensic and Scientific Services, Brisbane</p>	<p>Total THC and total CBD were quantified using an in-house method.</p> <p>Hemp seed samples were milled prior to extraction, while hemp powders and oils were analysed as received.</p> <p>1 g of homogenous sample was mixed with water and acetonitrile and cannabinoids extracted using a QuEChERS solid phase extraction kit.</p> <p>Extracts were analysed using High Performance Liquid Chromatography (HPLC) with either tandem mass-spectrometry (Sciex 5500 QTrap MS/MS coupled to a Shimadzu 30AD HPLC system) and/or a Thermo Scientific Q Exactive orbitrap MS coupled to a Thermo Vanquish HPLC system. HPLC mobile phase was water and 95% acetonitrile/5% water, both with 0.1% formic acid. The column (Luna Omega Polar C18, 50 x 2.1, 1.6 µm) was held at 40°C.</p> <p>Δ9-tetrahydrocannabinol (THC), tetrahydrocannabinolic acid (THCA) and cannabidiol (CBD) were quantified against calibration standards sourced from an ISO17034 accredited supplier.</p> <p>LOR: 1 ppm. MU: ± 50% at the 95% level of confidence.</p>

Laboratory conducted the testing	Methodology
Institute of Environmental Science and Research (ESR), Christchurch	<p>Total THC and total CBD were determined using in-house method based on the AOAC method.</p> <p><i>Solids (flour, protein powder, seeds, and other foods)</i></p> <p>A portion of sample (typically 100 mg) was weighed into a 4 mL glass vial. 50 µL of mixed internal standard solution and 2 mL of methanol was added and the sample vortexed briefly to fully wet and suspend the solid material. The vial was placed on an orbital shaker for approximately 1 hour at 250 rpm and then allowed to settle at room temperature. 0.7 mL of the supernatant was transferred to an autosampler vial and 0.3 mL distilled water was added prior to analysis by LC-MSMS.</p> <p>LOR for THC & CBD: 0.2 ppm. MU: ±10%</p> <p><i>Hemp Seeds Oils</i></p> <p>Oil samples were first diluted in hexane (2.5 g oil diluted to a final volume of 50 mL), then a 0.5 mL aliquot was transferred to a 4 mL glass vial. Internal standard and 1 mL acetonitrile was added and the contents were combined by on a vortex mixer. 200 mg QuEChERS salt (UCT QuEChERS 4g MgSO₄/1g NaCl/500mg Na₂Cit/1g Na₃Cit) was added and the contents again combined on the vortex mixer. The vial was then centrifuged for 10 minutes at 2700 rpm to separate the phases, the acetonitrile layer transferred to an autosampler vial and evaporated to dryness with gentle heating (40°C) under a nitrogen flow. The sample was redissolved in 0.7 mL methanol, and 0.3 mL distilled water was added prior to analysis by LC-MSMS.</p> <p>LOR for THC & CBD: 0.4 ppm. MU: ±10%</p>

Results analysis

The analytical testing results were assessed against the requirements outlined in Standard 1.4.4–6 of the Code (Table 2).

Table 2. Permitted level of total THC and CBD in *Cannabis sativa* seeds and seed products as per Standard 1.4.4 of the Code

Product	Total THC (mg/kg)	CBD (mg/kg)
Seeds of low-THC hemp	5	75
Oil – extracted from seeds of low-THC hemp	10	75
A beverage derived from seeds of low-THC hemp	0.2	75
Any other product that is extracted or derived from low-THC hemp	5	75

In addition, the label of each product was assessed against Part 1.2 of the Code – *Labelling and other information requirements* as well as Standard 1.4.4–7 – *Restriction on claims and representations about foods that are or which contain hemp food products*.

Results

Type of products

Types of products included in the survey can be found in Table 3.

Table 3. Types of low-THC hemp products included in the survey

Type of products	Number of products tested
Hemp seeds	55
Hemp oils	49
Hemp protein	41
Hemp flour	14
Hemp beverage	2
Other hemp products such as snack bars, crackers, spreads, breakfast cereal	40
Total	201

Visual examination

For hemp seed products, a visual examination was conducted by testing laboratories to confirm seeds are hulled⁵. All hemp seed products tested in this project were hulled.

⁵ Hulled seeds means seeds from which the outer coat or hull of seeds has been removed.

Country of Origin

For 166 products, the country-of-origin information was noted. Approximately 94% of the products were identified as made or packed in Australia and New Zealand.

Table 4. Country of origin for products surveyed

Country of Origin	Number of products
Made in Australia – from Australian ingredients	67
Made in Australia – from mixed of imported and local ingredients	25
Made in Australia – from imported ingredients	1
Made in Australia with unknown origin of the ingredients	7
Packed in Australia – from imported ingredients	18
Made in New Zealand – from NZ ingredients	25
Made in New Zealand – from mixed of imported and local ingredients	1
Packed in New Zealand – from imported ingredients	12
Canada	9
UK	1

THC and CBD level

96% of the products were found to be compliant with the permitted level of total THC in the Code. THC was detected in five hemp oil products at a level greater than 10 mg/kg (range: 10.2 – 13.0 mg/kg), one hemp seed product at the level of 5.7 mg/kg and two hemp protein products at a level of 5.2 and 6.0 mg/kg.

Note these values are the testing results reported by the laboratory, without applying the measurement of uncertainty (MU) of the method. When deciding the follow up action, the MU was considered especially for results close to the limit prescribed in the Code.

The THC and CBD testing results and the distribution graphs can be found in Appendix 1 and 2.

Table 5. Assessment of THC testing results against Standard 1.4.4–6 of the Code

Product	Compliant	Non-compliant
Hemp seeds (n=55)	54	1
Hemp oils (n=49)	44	5
Hemp protein (n=41)	39	2
Hemp flour (n=14)	14	0
Hemp beverage (n=2)	2	0
Other hemp products such as snack bars, crackers, spreads, breakfast cereal (n=40)	40	0
Total	193 (96%)	8 (4%)



Labelling assessment

The product labels of each of the 166 products were assessed against the general labelling requirement as outlined in Part 1.2 of the Code (Figure 1) and specific labelling requirements as outlined in Standard 1.4.4–7 (

Table 6). When assessed against the Standards in the Code, only 58 (35%) labels were found to be fully compliant. For the rest of the labels, non-compliance was found in one to six components of the Standard. One product did not have a label at all.

Figure 1. Labelling assessment of low-THC hemp products surveyed against Part 1.2 of the Code.

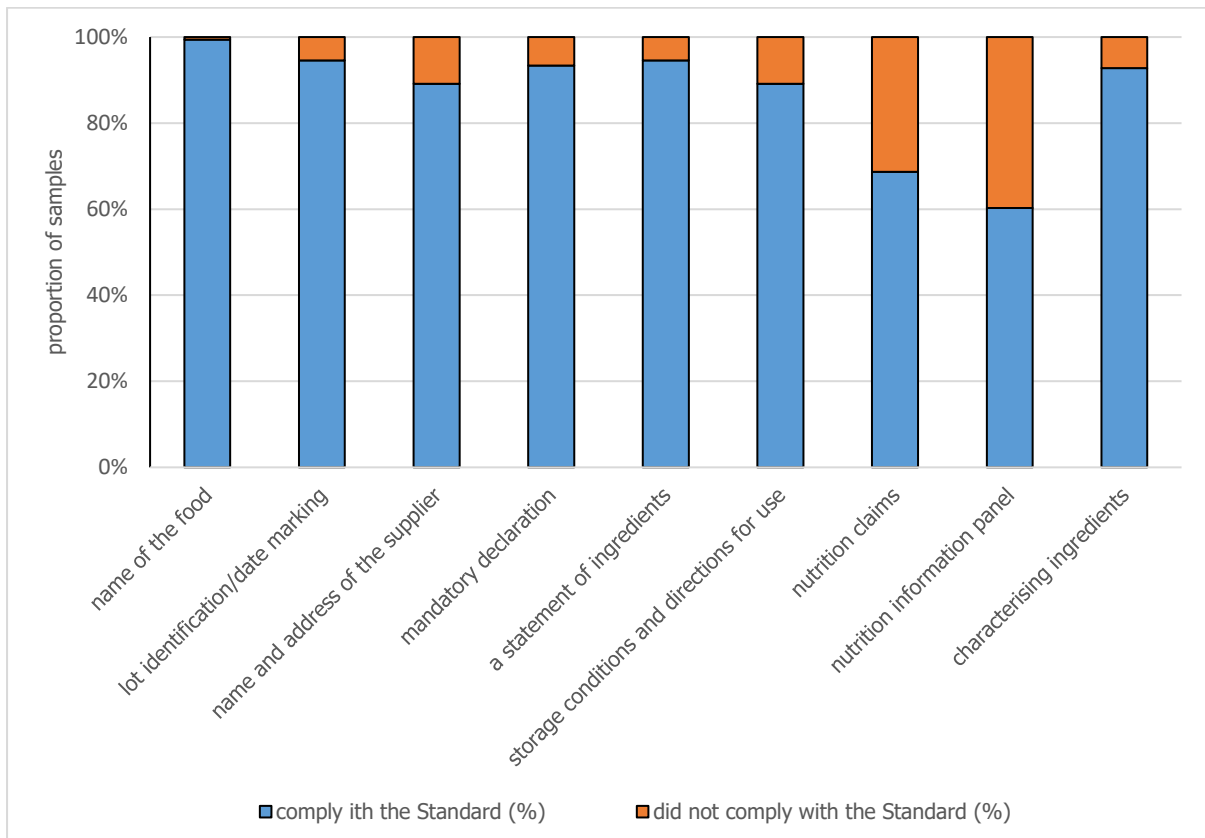


Table 6. Labelling assessment of low-THC hemp products surveyed against Standard 1.4.4–7.

Component in the Standard	Compliant	Non-compliant
A nutritional content claim about cannabidiol on the label	166 (100%)	-
A health claim about cannabidiol on the label	166 (100%)	-
An image or representation of any part of the <i>Cannabis sativa</i> plant other than the seed on the label	150 (90.4%)	16 (9.6%)
The words 'cannabis', 'marijuana' or words of similar meaning on the label	166 (100%)	-

The top five non-compliance issues with the labels as outlined in Part 1.2 (general requirements) and Standard 1.4.4–7 (specific requirements):

1. Standard 1.2.8 - Nutrition information requirements.

Three products did not have a Nutrition Information Panel (NIP). A further 63 products had a NIP but they did not comply with the Standard especially in relation to the statement of the name and average quantity of any other nutrient in respect of which a claim is made. For example, the label has a gluten free claim, but there was no gluten value listed in the NIP.

2. Standard 1.2.7 – Nutrition, health and related claims (not in relation to claim on cannabidiol).

A total of 52 products had non-permitted nutritional claims or unsubstantiated nutritional claims. Health related statements were also found on some of these products, for example “good for digestion, support memory and cognitive function”. These health claims are not permitted unless they comply with Standard 1.2.7 Division 5.

3. Standard 1.2.2 – Food identification: Name and address of supplier.

Eighteen products did not have the name or the physical address of the manufacturer or importer in Australia or New Zealand. An address with a PO Box or website only is not compliant with the Code.

4. Standard 1.2.6 – Directions for use and storage.

Eighteen products did not have directions for use and storage, allowing for incorrect temperature storage. For shelf stable products, the absence of storage condition labelling may cause quality deterioration as opposed to a food safety risk.

5. Standard 1.4.4 – The label for the food for sale must not include an image or representation of any part of the *Cannabis sativa* plant other than the seed.

A total of 16 products manufactured by 11 businesses had a logo or picture that represented *Cannabis sativa* leaf.

Discussion

Product testing revealed a high level of compliance with Standard 1.4.4 of the Code in terms of the total THC and CBD level in the products. Total THC was detected above the permitted level of 10mg/kg in five oil samples (10% of the hemp oil tested), ranging from 10.2 to 13.0 mg/kg. Three of the products were packed in Australia from imported ingredients and two products were from New Zealand. In addition, one hemp seed and two hemp protein products were found to contain total THC at levels above the limit of 5mg/kg, ranging from 5.2 to 6.0 mg/kg. One of the products was made in Australia, one was packed in Australia from imported ingredients and one is unknown. Currently, there is inconsistent regulations concerning the THC level allowed to be present in the food worldwide. One of the reasons for this is the lack of data describing consumption patterns of hemp-based food products (Kladar et al., 2021).

The results obtained in this study were consistent with similar recently conducted studies in Europe, the USA and Korea (Christinat, Savoy & Mottier, 2020; ElSolhy et al., 2020; Jang et al., 2020; Kladar et al., 2021). A significant decrease of total THC content in hemp seed oils was noticed when compared to earlier studies (Bosy & Cole, 2000; Lachenmeier & Walch, 2005; Petrovic et al., 2015). Kladar (2021) attributed the finding to agricultural advances in hemp cultivation, as well as measures applied in edible oil production. In some countries, the availability of a defined list of hemp varieties allowed for cultivation that significantly reduces the risk of growing plants with high THC content. Industry awareness of the techniques for obtaining seeds from plants has increased, and the development of washing techniques which remove THC from the seed surface prior to pressing, allow the production of low THC hemp-based food products.

In low-THC plants, THC is localised primarily in the upper third of the stalk, leaves, and the flowers. Little or no THC is found in the seeds or roots of the plant (Slatkin et al., 1971). Seed size, oil content and oil composition vary amongst hemp cultivars. Tall growing hemp plants are more prone to wind and hail damage. These and other environmental stresses can result in increased THC levels. Harvesting for seed occurs four to six weeks later than fibre harvest (approximately 100 to 140 days after planting), when 60 to 70% of the seed has ripened. Mechanical harvesting for hemp is yet to be refined in Australia, and currently harvesting is conducted using sickle bar mowers and hay swathers. There are also contractors available for the harvest operation. After harvesting, grain should be dried to below 12% moisture for short-term storage and to 8 to 10% for long-term storage (Agrifutures Australia, 2017; Kaiser, Cassady & Ernst, 2015).

Hemp seed oil is produced by cold pressing the hemp seeds. There are various extraction processes to obtain the hemp oil. Hemp oil extracted using different processes may differ in quality, quantity and chemical composition. THC present in hemp oils generally comes from extraction of THC from the leaf and resin material that is attached to the seeds during harvesting. The exterior of the seeds become contaminated with the resin in the leaves through mechanical rubbing of the seeds and the leaves during processing. A higher level of THC in oil is most likely due to poor seed cleaning and preparation, or sourcing from a supplier that distributes seeds from plants that inherently contain greater THC levels. There

is also a high level of variability between batches because the oil comes from different plants (Bosy & Cole, 2000; Citti et al., 2019; Devi & Khanam, 2019; Petrovic, 2015).

All hemp seeds tested in this survey were hulled, so it is not unusual to find low levels of THC and CBD on them. The fact that hemp protein was made by crushing the hemp seeds also contributed to the low level of THC and CBD in these products.

Other products with hemp as an ingredient also contained very low levels of total THC and CBD. It is not unusual considering the nature of the products and the fact that only a small percentage of hems seeds are present in them, considerably reducing the cannabinoids levels. Similar results were found by Christinat et al. (2020) and Kladar et al. (2021).

Less than half of the products had compliant labels with the Code requirements. The most common instances of non-compliance related to nutrition information requirements and unsubstantiated nutritional or health claims. About 10% of labels had an image or representation of *Cannabis sativa* leaf that constitutes a breach on the requirement outlined in Standard 1.4.4.

Follow-up actions

When a product was found to be non-compliant with the Code, the food regulator from the jurisdiction where the manufacturer or importer is located conducted a follow-up action as per jurisdictional enforcement procedures. Follow-up work on the findings was conducted in October 2021 to March 2022. Some products had multiple issues, therefore a decision on the appropriate follow-up action was based on the most serious breach to the Code.

Follow up actions taken as part of the survey⁶ included:

- An advisory letter was sent to the manufacturer or importer of products with non-compliant labels against the general labelling requirement (Part 1.2 of the Code). The letter informed the manufacturer or importer of the issue identified and asked them to rectify the issue. In total, 38 advisory letters were sent.
- A warning letter was sent to the manufacturer or importer of products with non-compliant label against the specific labelling requirement in Standard 1.4.4–7. The letter outlines the breach to the Standard and the manufacturer or importer was instructed to rectify the issue immediately. In total, nine warning letters were sent.
- Inspection of the manufacturer or importer's premises was conducted by the authorised officer from the food regulatory agency when a product was found to contain non-compliant levels of total THC. During the inspections, the non-compliance was discussed and more products were collected and tested. In total, five inspections were conducted.

⁶ The number of actions taken is accurate at the time when the report is written. Additional follow up actions might be conducted at later date.

Conclusions

Product testing revealed that 96% of products tested in this survey complied with the total THC limits prescribed in the Code. In addition, all products complied with the CBD limit in the Code. Ongoing quality control is needed to maintain low-THC levels, including the use of low-THC hemp varieties and proper seed cleaning.

However, more than half of the products surveyed did not comply with the labelling standards in the Code. Education is required on the food labelling requirements for this industry sector.

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Appendix 1. Total THC testing results

Table A1. Total THC testing results

Sample type	No of samples	Samples < LOR	THC concentration* (mg/kg)			
			minimum	median	mean	maximum
Hemp seeds	55	30	0.1	0.9	1.1	5.7
Hemp oils	49	13	0.3	3.5	4.6	13.0
Hemp protein	41	18	0.1	1.2	1.6	6.0
Hemp flour	14	4	0.2	0.9	1.4	3.6
Other hemp products	40	35	0.2	0.3	1.1	3.6

* For samples above the LOR

Figure A1. Total THC level in hemp seeds tested in the survey

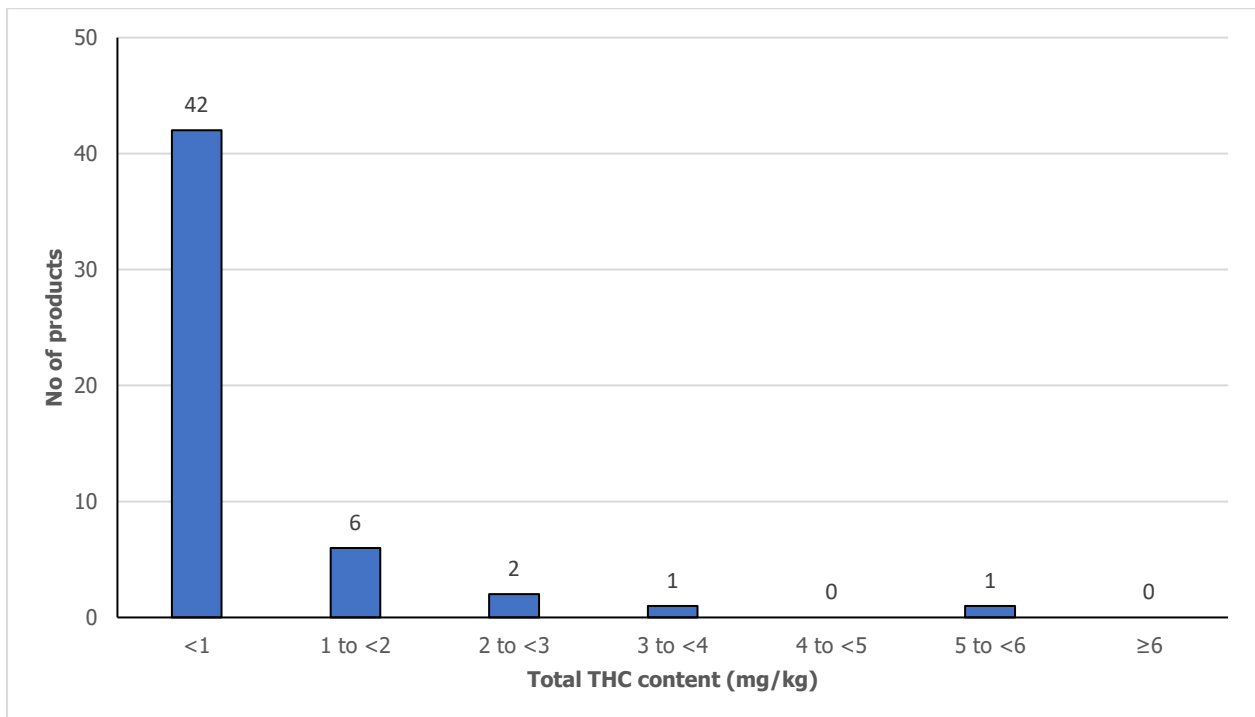


Figure A2. Total THC level in hemp oils tested in the survey

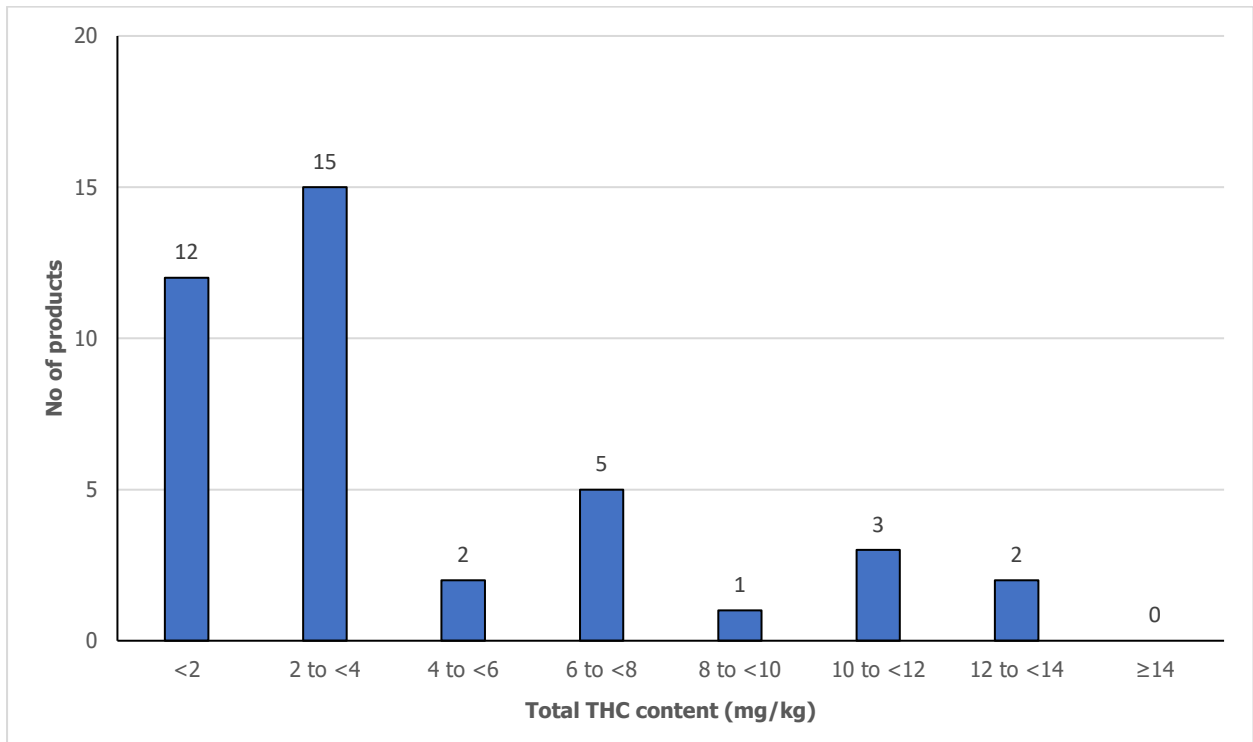


Figure A3. Total THC level in hemp protein tested in the survey

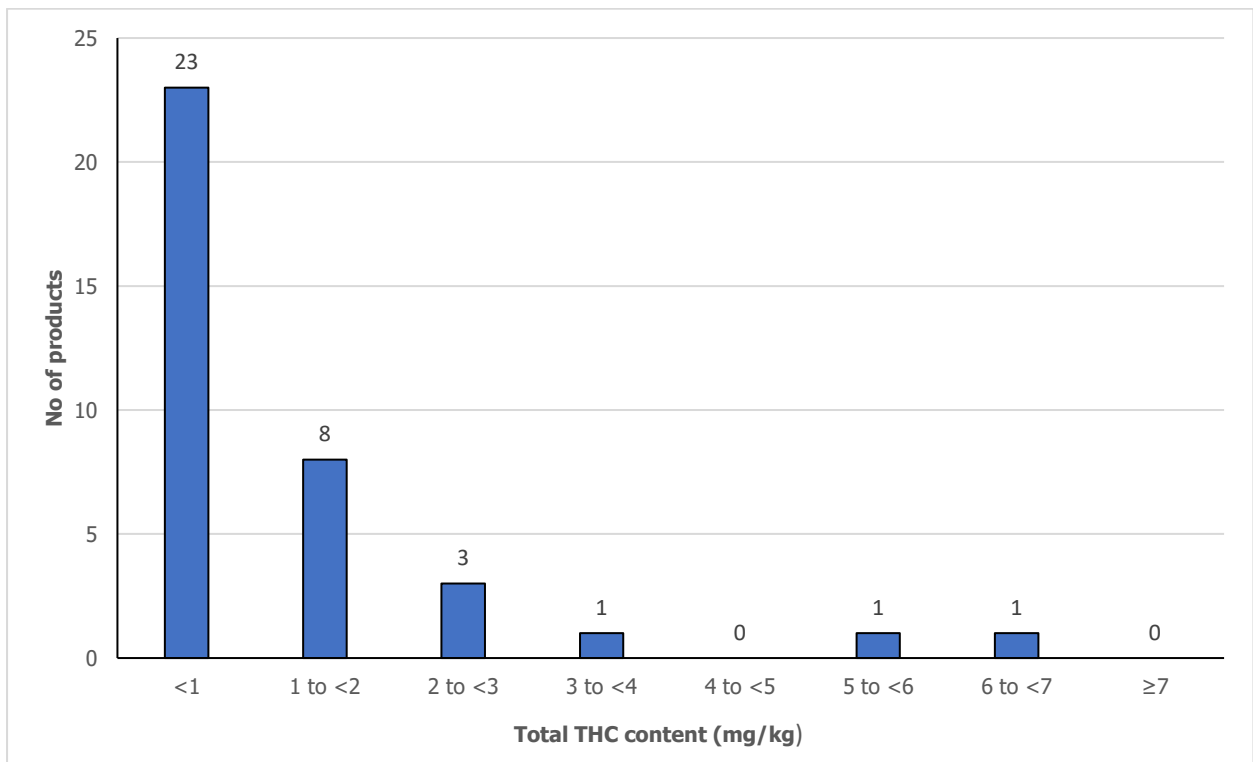


Figure A4. Total THC level in hemp flour tested in the survey

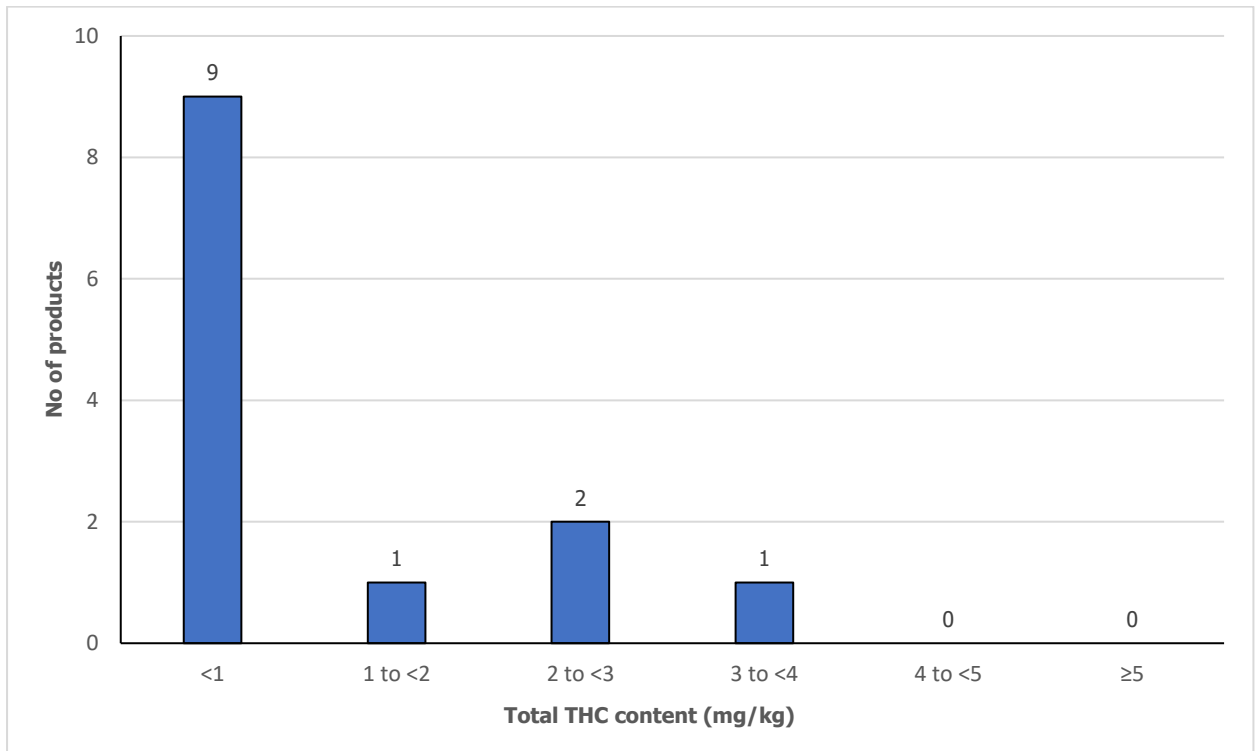
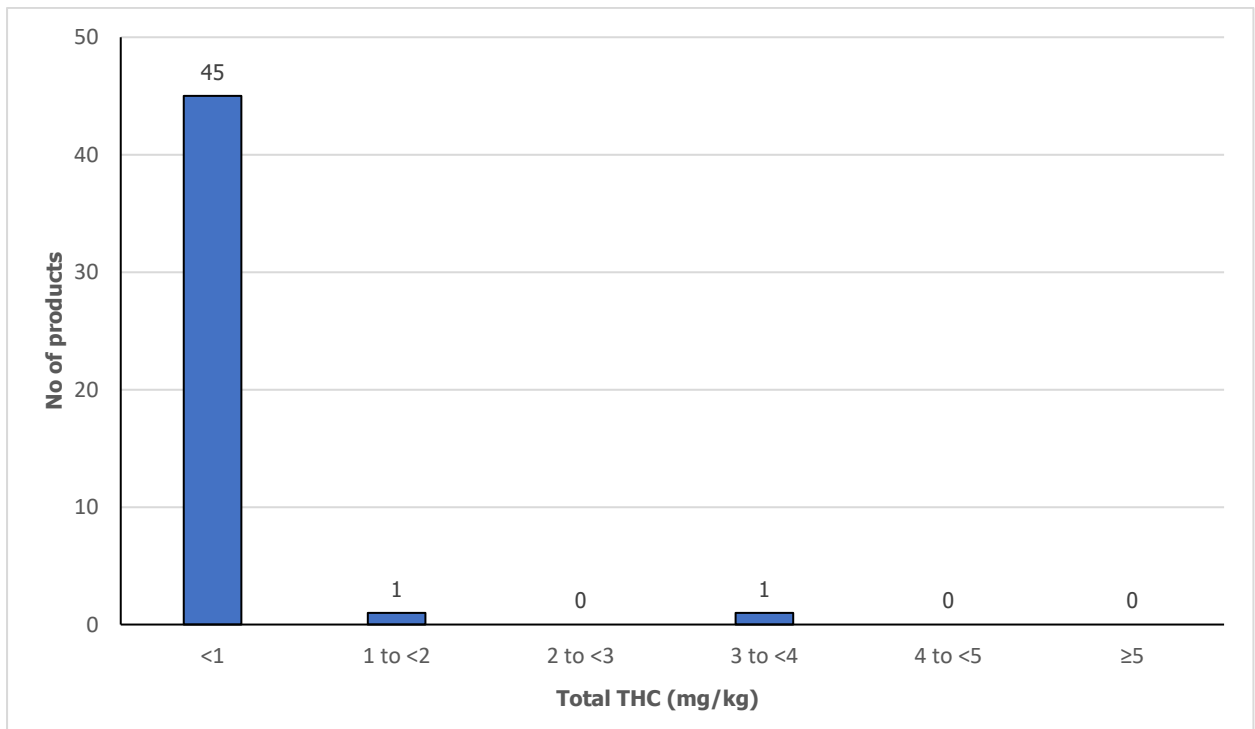


Figure A5. Total THC level in other products containing hemp as an ingredient



Appendix 2. CBD testing results

Table A2. CBD testing results

Sample type	No of samples	Samples < LOR	CBD concentration* (mg/kg)			
			minimum	median	mean	maximum
Hemp seeds	55	19	0.3	1.5	1.8	9.3
Hemp oils	49	8	1.0	9.6	11.3	48.0
Hemp protein	41	15	0.6	3.6	4.2	14.0
Hemp flour	14	2	1.5	3.0	6.0	32.0
Other hemp products	40	31	0.2	0.5	0.9	2.2

* For samples above the LOR

Figure A6. CBD level in hemp seeds tested in the survey

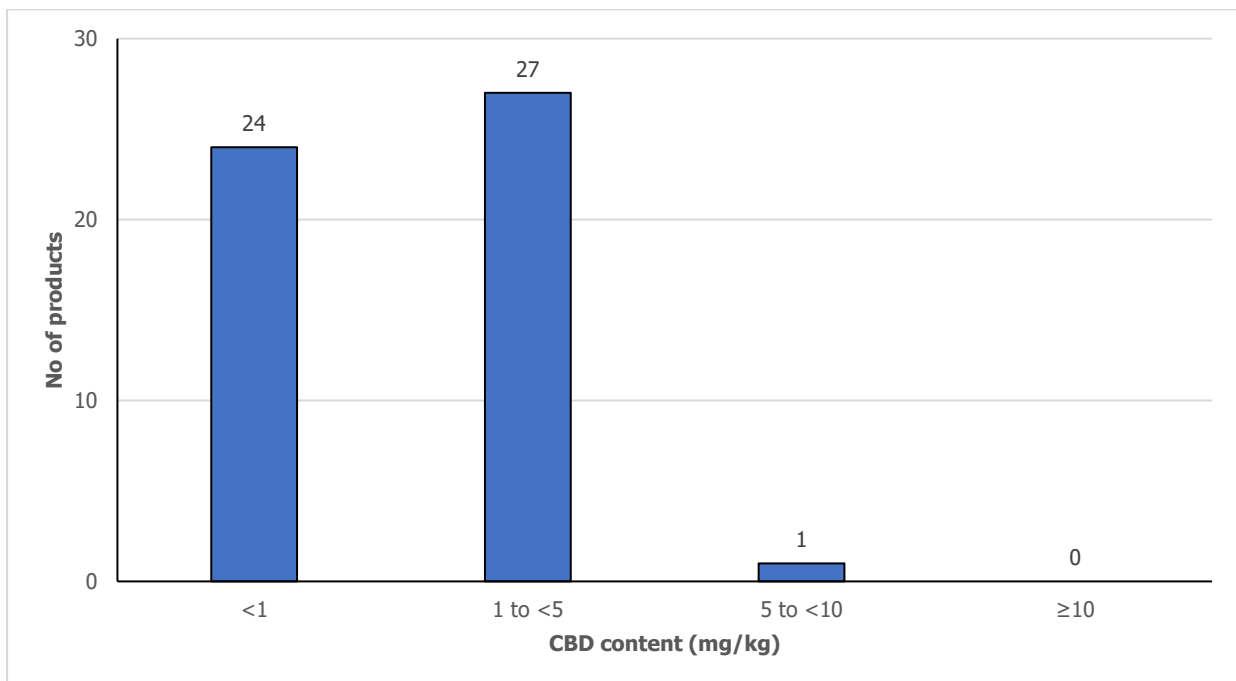


Figure A7. CBD level in hemp oils tested in the survey

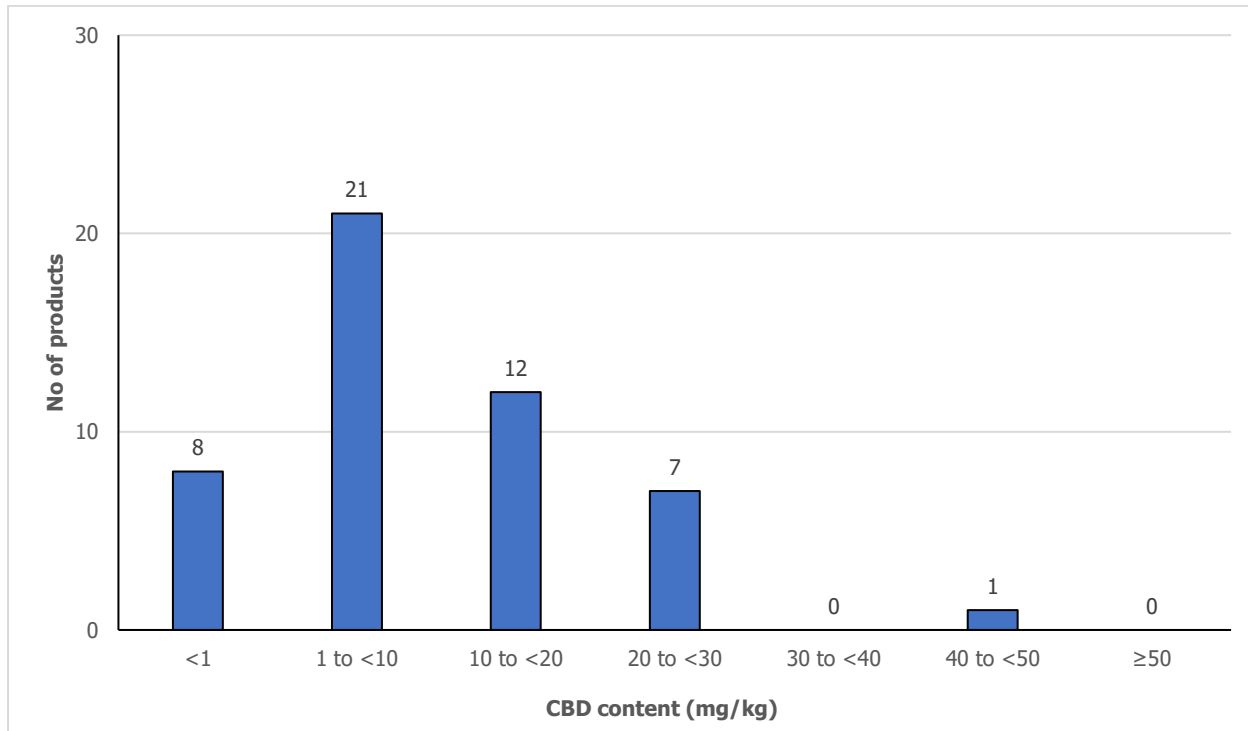


Figure A8. CBD level in hemp protein tested in the survey

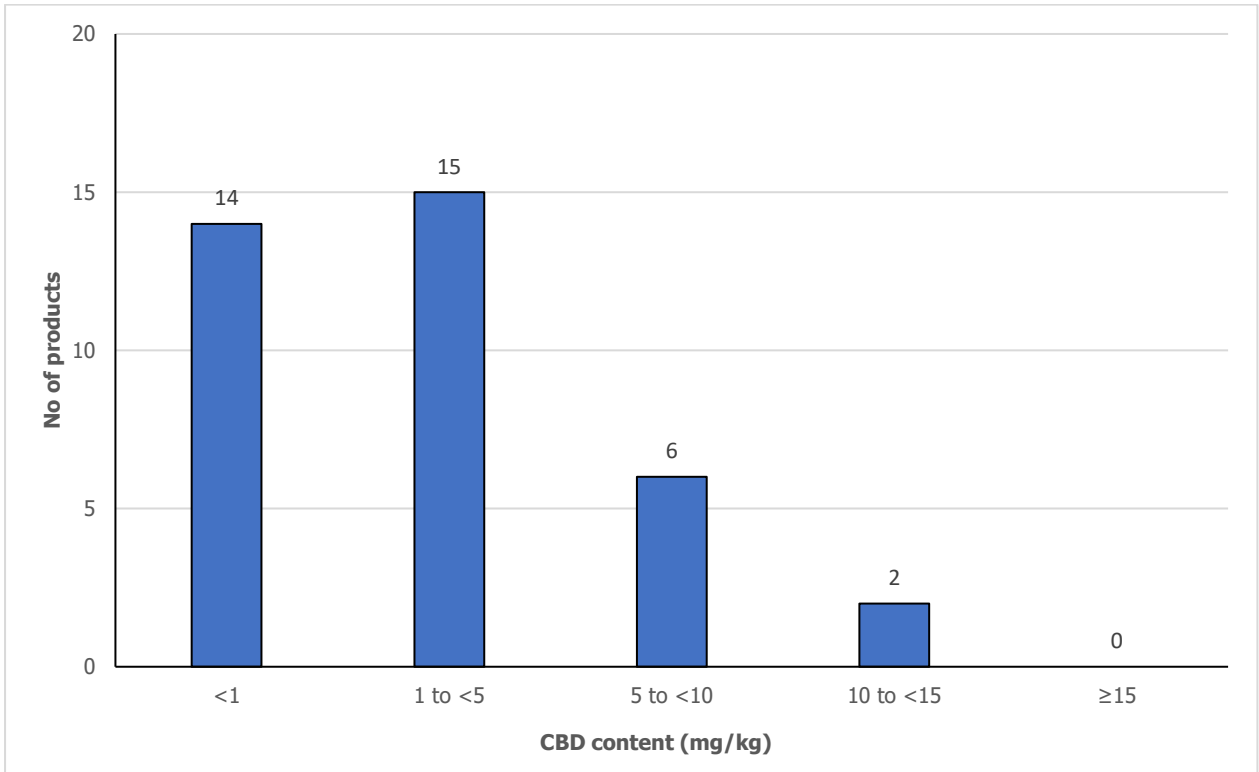


Figure A9. CBD level in hemp flour tested in the survey

