ANALYTICAL QUALITY AND SAFETY STUDY OF COMMERCIAL OILS WITH CANNABIDIOL

In 2018, the Observatorio Español de Cannabis Medicinal – OECM (Spanish Medical Cannabis Observatory) carried out an analytical study of samples of commercial cannabis oils enriched in cannabidiol (CBD). Specifically, two different batches of 15 brands of oils were studied, considered as representative of consumption standards by medicinal users in Spain. Analyses included quantification of active substance concentration (CBD), together with that of related phytotocannabinoids A^9-tetrahydrocannabinol (THC), A^9-tetrahydrocannabinol acid (THCA) and cannabidiol acid (CBD), as well as the possible presence of chemical contaminants, namely metals and pesticides.

Blind experimental determinations were carried out by qualified technical personnel from two different entities:

- Narcotics Analysis Unit of the Public Health Laboratory of Madrid (Madrid City Council). See Annex I for experimental details.
- Fundación CANNA Laboratory. See Annex II for experimental details.

Interpretative summary of the results obtained

1. Phytocannabinoids

(A) 5 of the 15 oils analysed (Cannamor 2.5%, Enecta 3%, Vitalhemp 2.5%, Endoca 3% and Sativida 4%) present levels of CBD that correspond to the levels on the label in both lots. Endoca 3% also contains significant levels (~ 0.2%) of THC.

(B) 3 of the 15 oils analysed (Cibiday 4.5- 5%, Royal Queen Seeds 2.5% and Cibdol 2.5%) have CBD levels that correspond to the label in one of their lots, but not in the other.

(C) 7 of the 15 oils analysed (CBD Cure 10%, Medihemp 6%, Cannabigold 10%, Sensiseeds 3%, MyCBD 2%, De Primera 2.5% and Vitrovit 2.5%) have CBD levels that do not correspond with the label in either of the two batches. In some cases (CBD Cure 10%, Cannabigold 10%, Lot 2 Medihemp 6% and Lot 2 MyCBD 2%), the discrepancy could e due to incomplete decarboxylation of the CBDA. In other cases (Sensiseeds 3%, Lot 1 Medihemp 6% and Lot 2 De Primera 2.5%), quantities of CBD moderately lower than those labelled were detected. In other cases (Vitrovit 2.5% and Lot 1 De Primera 2.5%), much lower amounts of CBD than those labelled were detected. In one case (batch 1 myCBD 2%), quantities of CBD higher than those labelled were detected.

2. Metals

Overall, the levels of the metals analysed in the samples were considered to be negligible. The only exceptions were Lot 1 Cannamor 2.5%, in which 0.48 mg/kg lead was detected, and Lot 2 Endoca 3%, in which 3.8 mg/kg copper was detected. In any case, neither of these two values is considered alarming for human consumption.

3. Pesticides

The levels of pesticides analysed in the samples were considered to be globally low and not threatening to human consumption. However, it should be noted that, while in some oils, at least one of their lots, one or more pesticides were detected in quantities exceeding the limit of quantification of the technique used, in other oils no pesticide was detected in either of the two batches analysed. These “pesticide free” oils were Cannamor 2.5%, Enecta 3%, Cannabigold 10%, Cibdol 2.5%, Sativida 4% and De Primera 2.5%.

4. Other aspects - Labelling

Several brands use on their label terms such as “natural phytocannabinoids” / “phytocannabinoids rich hemp extract” (Cannabigold 10%), “hemp oil extract” (CBD Cure 10%), “CBD extract” / “Hemp oil” (Vitalhemp 2.5%), “Hemp extract” / “CBD and other beneficial phytotocanabinoids” (De Primera 2.5%) or “CBx oil” / “hemp oil” (Vitrovit 2.5%), which are confusing for the consumer because they can include unspecified phytotocannabinoids other than CBD. One brand (Medihemp 6%), highlights “CBD oil” on its label although it contains significant amounts of CBDA. Several brands highlight terms such as “100% organic hemp” (Endoca 3%), “organic culture” (MyCBD 2%) “organic farming” (Medihemp 6%), “100% natural” (Sensiseeds 3%) or “certified organic farm hemp resin” (CBD Cure 10%) on their labels, although they give positive results for metals and pesticides. Two brands highlight that their product is GMP (Endoca 3% and Sativida 4%). Three brands do not state a lot number (Cibiday 4.5- 5%, Sativida 4% and De Primera 2.5%).

Opinion

- Only 5 of the 15 oils contain, in the two batches analysed, levels of CBD that correspond to the levels on the label.
- The levels of metals and pesticides analysed are considered to be globally low and not threatening for human consumption. However, some oils are more free of these contaminants than others.
- It would be advisable that, in general, brands should carefully review the labelling of their products and verify that they are completely accurate.
- Overall, and considering the different parameters analysed, the oils that in this study appear to be most appropriate for human consumption are Enecta 3% (lots number 0-205 and 0-331) and Sativida 4% (lots not numbered).
- The traceability of a product involves a set of measures, actions and procedures that allow the recording and identification of each batch of the product from its origin to its final destination, which ensures the user a safe and controlled consumption. Therefore, it would be desirable to implement an *ad hoc* regulatory framework in order to adequately assess the quality and safety of CBD oils used for medicinal purposes, as well as to control their production, processing and distribution.

This study is only applicable to specific oil batches analysed. The data cannot therefore be extrapolated to other batches or products of the same brands. The OECM would like to continue carrying out similar analytical studies in the future.

The OECM will deliver to any brand that requests it, through the address contacto@oedcm.com, the numerical data set of the analyses carried out on its two oil batches.

The data obtained in this study cannot be used for commercial purposes.

Madrid, 18 December 2018 OECM

QUALITY CONTROL IN CANNABIS OIL SAMPLES

Narcotics Analysis Units

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In the **Public Health Laboratory, Madrid** (LSP) a total of 30 samples of *cannabis* oil for medicinal use were analysed (these are two different batches of 15 samples, the first batch was analysed in February 2018 and the second in August 2018), in order to verify the quality of the product, as well as the possible presence of chemical contaminants (metals and pesticides).

OBJECTIVE

Study the content of the active substances cannabidiol (CBD) and A^9-tetrahydrocannabinol (THC) in the samples.

Analyse the different samples to check the presence of possible contaminants that may affect the health of consumers.

RESULTS

CBD and THC CONTENT

Technique used: **Liquid Chromatography/Mass Spectrometry (CL-MS/MS)**

Principle of the method: Samples were previously homogenized by stirring. The THC and CBD content present in the samples is extracted by agitation with methanol. The obtained extract was diluted and injected directly into the CL-MS/MS equipment. Quantification was carried out by extrapolation in the calibration metric from calibration standards prepared in dissolution.

CBD detection limit: 10 ng/ml THC

detection limit: 20 ng/ml

Conclusions: It was found that in 5 of the 15 commercial cannabis oils analysed, the CBD content does not correspond to that indicated on the product label, which may be a fraud for consumers.

METAL ANALYSIS

Technique used: **Inductive Coupling Plasma with Mass Spectrometry Detector (ICP-MS)**

Principle of the method: The test method is based on *(EC) Commission Regulation 333/2007 of 28 March 2007* laying down methods of sampling and analysis for the control of trace element levels and contaminants in foodstuffs and their amendments.

Six heavy metals were analysed, the quantification limits of which are expressed in the following table:

Determination	Quantification limit (mg/kg)
Arsenic	0.010
Cadmium	0.0040
Copper	0.05
Mercury	0.0050
Nickel	0.050
Lead	0.010

Conclusions: The values found for heavy metals in the samples are minimal and in no case exceed statutory values in edible oils.

Of the elements analysed, significant values were only found in the case of **copper**. As a rule, oils do not contain copper, and in fact they cannot contain more than 0.10 mg/kg. This suggests that the copper present in the oils comes from the cultivation of the *cannabis* plant, as already observed in the analysis carried out in 2017 on cannabis samples in herbal form.

In any case, copper is an essential element and is necessary in low doses for humans. The concentrations found, less than 1 mg/kg, are not considered problematic. Only in one case, that of sample IS-1804137, concentrations were found with which some caution should be exercised, although it is not in any case an alarming amount.

ANALYSIS OF PESTICIDE RESIDUES

Technique used: **Gas Chromatography/Triple Quadruple Mass Spectrometry (CG/MS/MS) and Liquid Chromatography/Triple Quadruple Mass Spectrometry (CL/MS/MS)**

Principle of the method: After homogenizing the samples by stirring, pesticide residues and analogues were extracted from the oil with acetonitrile and a mixture of salts. The obtained mixture was stirred and centrifuged. An aliquot was taken from the liquid extract, filtered and a dilution made to be finally analysed either by Cg/MS/MS or by CL/MS/MS.

Limit of quantification for all analytes was 0.010 mg/kg.
A total of 279 pesticide residues were analysed, of which 183 were determined by GC/MS/MS and 96 by CL/MS/MS.

Conclusions: There are no reference values (maximum residue limits - MRLs) established for pesticides in *cannabis* oils. The most reliable reference would be the MRLs for olive oil (majority excipient). For this product, the tested samples comply with the established legal requirements. The values obtained were not particularly high in relation to other plant products analysed in the laboratory.

The underlying problem is that if cannabis oil is in a 5:95 ratio (cannabis extract: oil), and given that olive oils of a certain quality usually do not contain pesticide residues, this means that pesticides come from hemp oil and these are in a high concentration in hemp oil. In other words, 0.1 ppm in actual sample would be converted to 2 ppm in hemp oil, which can pose a health risk. One of the samples reports that it is made from organic hemp, and curiously this was the one with the highest number and concentrations of pesticides.

The tables below show the list of all pesticides studied.

Pesticide residues by gas chromatography with mass spectrometry detector (CG-MS-MS)

2-phenylphenol	Endrin ketone	Nitrofen
3,5-dichloroaniline	EPN	Nonachlor, cis-
4,4-dichlorobenzophenone	Spiromesifene	Nonaclor, trans-
Acetoclor	Etalfluralin	Norflurazon
Acrinathrin	Etilan	Oxadiazon
Alachlor	Etion	Oxifluorfen
Aldrin	Etopenprox	Paclobutrazol
Antraquinone	Ethoprophos	Paration Ethyl
Atrazine	Etridiazole	Paration Methyl
Azinphos-methyl	Phenamidone	Penconazole
Benalaxyl	Phenamiphos	Pendimethalin
Benfluraline	Phenarimol	Pentachloroaniline
Piperonyl butoxide	Fenitrotion	Permethrin
Hexachlorocyclohexane-alpha	Fenpropatrine	Pyrazophoos
Hexachlorocyclohexane-beta	Fenson	Piridaben
Hexachlorocyclohexane-delta	Fention	Pyrimethanil
Bifentrin	Fentoate	Pirimicarb
Bromfenvinfos	Fipronil	Pyrimifos Methyl
Bromophes	Fluazifop-butyl	Pyrimifos ethyl
Ethyl bromophes	Fludioxonil	Piriproxyfen
Bromopropylate	Fluquinconazole	Pretilachlor
Bupirimate	Fluridone	Procimidone
Buprofezin	Flusilazole	Prochloraz
Carfentrazone-ethyl	Flutolanil	Prodiamine
Chlorobenside	Flutriafol	Profenophos
Chlordan-CIS (alpha)	Fluvalinate I and II	Profluralin
Chlordan-trans (gamma)	Folpet	Propaclor
Chlorfenson	Phonophos	Propanil
Chlorprofam	Forato	Propiconazole
Chlorthiophos	Phospalon	Propisochloride
Clozolinate	Fosmet	Propyzamide

Cyfluthrin	Heptachlor	Protiophos
Cyhalothrin lambda	Heptachlor exo-epoxy	Pyraclofos
Cypermethrin	Hexachlorobenzene	Pyridafenthion
Ciproconazole	Hexaconazole	Quinalfós
Cyprodinil	Hexazinone	Quinoxyfen
Clomazone	Imazalil	Fenchlorphes)
Chlorfenapyr	Iodofenphs	Sulfotep
Chlorfenvinfos	Iprodione	Sulprofos
Chlorobenzylate	Isodrin	Tebuconazole
Chlorothalonil	Isophenphos-methyl	Tebufenpirad
Chlorpyriphos	Isopropalin	Tecnazene
Chlorpyriphos-methyl	Kresoxim Methyl	Tefluthrin
Coumaphos	Lenacil	Terbacillus
Cycloate	Leptophos	Terbufos
Chlortal dimethyl	Lindane (HCH gamma)	Terbutylacin
Dialate	Malaoxon	Tetrachlorvinphos
Diazinon	Malation	Tetraconazole
Diclofluanide	Mecarbam	Tetradifon
Dieldrin	Metalaxyl	Tolclophes Methyl
Dietofencarb	Metazachlor	Tolylfluanide
Diphenylamine	Metacrifos	Transfluthrin
Dimethachlor	Metidation	Triadimefon
Dimethoate	Methoxychlor	Triadimenol
Diphenamide	Methoxychlor, o, p'-	Trialate
Disulfoton	Methoxychlor, p, p'-	Triazophos
Edifenfos	Metolachlor	Tricyclazole
Endosulfan sulfate	MGK-264	Trifloxystrobin
Endosulfan-alpha	Mylobutanil	Triflumizol
Endosulfan-beta	Mirex	Trifluraline
Endrin	Nitralin	Vinclozolin

Pesticide Residues by Liquid Chromatography with Mass Spectrometry Detector (CL-MS-MS)

3-Hydroxy-carbofuran	Ethofumesate	Metomyl
Acephate	Ethoxazole	Metoprotrin
Acetamiprid	Famoxadone	Methoxypheno zide
Aldicarb sulfone	Fenbuconazole	Mevinfos
Aldicarb sulfoxide	Phenobucarb	Mexacarbato
Ametrin	Fenoxycarb	Miclobutanil
Azoxystrobin	Phenpyroximate	Monolinuron
Benalaxil	Fenpropimorph	Nitenpiram
Bendiocarb	Fenuron	Ometoate
Benzoximate	Flonicamid	Oxamil
Bifenazate	Flufenacet	Picoxystrobin
Butafenacil	Flufenoxuron	Piracarbolid
Butoxicarboxim	Fluometuron	Pyraclostrobin
Carbendazine	Fluoxastrobin	Promecarb
Carbetamide	Forchlorfenuron	Prometon
Carbofuran	Fuberidazole	Prometrin
Carboxin	Furalaxil	Propargite
Cyclouron	Furathiocarb	Propoxur
Clofentezine	Halophenozide	Rotenone
Chloroxuron	Imidacloprid	Secbumeton
Chlortoluron	Indoxacarb	Siduron
Clothianidine	Iprovalicarb	Symmethrin
Dicrotophos	Isoprocarb	Tebutiuron
Dimethoate	Isoproturon	Temephos
Dimethomorph	Linuron	Terbumeton
Dimoxystrobin	Mandipropamid	Terbutrine
Dinotefuran	Mefenacet	Thiabendazole
Dioxacarb	Mepronil	Thiacloprid
Diuron	Metabenzthiazuron	Thyamethoxa m
Spirodiclofen	Metconazole	Thiobencarb
Etiofencarb	Metiocarb	Vamidotion
Ethyrimol	Metobromuron	Zoxamide

GENERAL CONCLUSIONS

All the analyses carried out were carried out under strict **QUALITY CONTROLS** following the ISO 17025 standard criteria implemented in the Madrid City Council Public Health Laboratory.

This confirms the need for a **REFERENCE LEGISLATION** to be able to correctly assess the health risks of consumers that may be posed by the presence of contaminants in *cannabis* oils used for medicinal use.

Regular quality and safety controls by accredited laboratories are required in the production of *cannabis* plants and in the production of oils intended for consumption.

There is a need to monitor the distribution of the final product to consumers.

Madrid, November 15, 2018

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SUMMARY OF THE METHODS USED IN THE STUDY OF THE QUALITY OF COMMERCIAL OILS WITH CANNABIDIOL (CBD)

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1. -QUANTIFICATION OF THE PHYTOCANNABINOIDS CBDA, CBD, THCA AND THC BY HPLC-UV

1.1. Methodology

Oil samples were dissolved/diluted in methanol. Each sample was weighed, extracted and analysed in duplicate. The determination was performed by separating the analytes of interest in a C18 column into an HPLC and their detection by UV. The limit of quantification (LOQ) established for the four analytes and the surrogate was 0.033% p/p in sample.

At the beginning of each analysis sequence, the instrument was calibrated with 6 points at 6 different concentrations of the four analytes and the surrogate with certified standards. The lowest point of the metric was below the LOQ. Calibration was performed by internal standard (IS) and external standard.

To verify that the calibration was correct, a standard was prepared with the four analytes of interest and the surrogate at a known concentration using a lot other than the one used for the initial calibration. This checking standard was analysed immediately after the calibration standards.

The detection limit (LOD) and LOQ value for an oily matrix was determined using a mixture of olive oil and hemp to which an amount of the four analytes and the surrogate not more than twice the theoretical LOD was added. Subsequently, the LOQ value was verified by analysing an oil sample target to which the phytocannabinoids of interest were added and the surrogate at a value close to the established LOQ.

Other quality controls used were: reagent target, sample target, surrogate standard, fortified sample and duplicate fortified sample and continuous calibration verification.

2. - DETERMINATION OF HEAVY METALS

2.1. Determination of Mercury in direct Hg analyser

A 30 mg sample of cannabis oil was placed in quartz cells. The cells were placed in the mercury analyser auto-sampler and the mercury measured. The sample was analysed in duplicate.

Samples were analysed using the direct mercury analyser. The equipment consists of three measuring cells with different sensitivities, so that samples can be measured in different mercury concentration ranges.

For quantification, three calibration metrics were constructed, one in each measurement cell, with the 15 mercury standards, prepared from the reference material.

As a quality control, samples fortified to the limit of quantification were used. Each analysis sequence analyses a target method to ensure the absence of mercury throughout the system

Linearity, accuracy, precision and uncertainty were determined.

The Quantification Limit was set at 0.1mg/kg

2.2. Determining of As, Cd and Pb by ICP/MS

A 0.5 g sample of cannabis oil was placed in the digestion tubes, digested and placed in the ICP/MS auto recorder next to the calibration standards.

The masses used in quantification were As (75), Cd (111) and Pb (208) and as internal standards Ge (72), Rh (103) and Lu (175) were used.

For quantification, a calibration metric was constructed with seven standards prepared from the reference material. As a quality control, samples fortified to the limit of quantification were used. A white method was analysed in each analysis sequence.

Linearity, accuracy, precision and uncertainty were determined.

The limit of quantification was established at 0.01 mg/kg for lead and cadmium and 0.05 mg/kg for arsenic.

3. - QUANTIFICATION OF PESTICIDES

A multistandard solution was used as reference material for calibration, consisting of a mixture of 365 pesticides in acetonitrile with a concentration of 1 mg/l of each of them. From this reference material solutions were prepared for the calibration metric.

A 1.5 g sample was extracted using QuEChERS. The clean extract was stored in a vial for further analysis by GC/MS and LC/MS.

3.1. Quantification in GC/MS

For each pesticide there were 2 parent ion - product ion transitions, which must maintain a certain area relationship between in order for the pesticide to be positively identified.

In order to analyse cannabis oil with a commercial oil, a recovery and validation study of cannabis oil with calibrating metrics constructed in olive oil was carried out. Calibration metrics with a minimum of 4 standards were constructed for quantification in a concentration range of 1 to 100 ug/l.

3.2. Quantification in LC/MS

For each pesticide there were 2 parent ion - product ion transitions, which must maintain a certain area relationship between in order for the pesticide to be positively identified.

As with quantification in GC/MS, in order to analyse cannabis oil with a commercial oil, a recovery and validation study of cannabis oil with calibrating metrics constructed in olive oil was carried out.

For quantification, a calibration metric with a minimum of 4 standards was constructed in a concentration range of 1 to 100 ug/l.

Pesticides that have passed validation tests and their LOQ are as follows:

Determination by CG/MSMS

ANALYTE	LQ (mg/kg)
2-phenylphenol	0.05
Acrinathrin	0.05
Alachloride	0.01
Boscalid	0.05
Chloroneb	0.05
Chlorthion	0.05
Cyfluthrin	0.05
Cypermethrin	0.05
Chlorbufam	0.05
Chlorpyriphos	0.05
Methyl-Chlorpyriphos	0.05
Chlorprofam	0.05
Chlozolinate	0.01
Coumaphos	0.05
Kresoxim-methyl	0.05
Crimidine	0.01
Cyanophos	0.01
Dichlobenil	0.01
Dichlofenthion	0.05
Diethofencarb	0.05
Esfenvalerate	0.05
Ethoprophos	0.01
Famoxadone	0.05
Fenitrothion	0.05
Fenson	0.01
Phentoate	0.05
Fenvalerate	0.05
Fluchloralin	0.05
Flucythrinate	0.05
Flumioxazin	0.05
Flurprimidol	0.01
Heptenophos	0.01
Indoxacarb	0.05
Isazophos	0.01
Isofenphos	0.01
Isofenphos-methyl	0.01

ANALYTE	LQ (mg/kg)
Malathion	0.01
Methacrifos	0.01
Metalaxyl	0.05
Methidathion	0.05
Metalochlor	0.05
Metrafenone	0.05
Molinate	0.05
Nitrotel-isopropyl	0.01
p.p-DDD+o,p-DDT	0.05
Parathion	0.01
Parathion-methyl	0.05
Pendimethalin	0.05
Perthane	0.05
Picoxystrobin	0.01
Pirimiphos-methyl	0.01
Propetamphos	0.01
Prosulfocarb	0.05
Prothiofos	0.05
Terbacil	0.05
Tolclofos-methyl	0.01
Transfluthrin	0.05
Vinclozolin	0.01

Determination by HPLC/MSMS

ANALYTE	LQ (mg/kg)
3,4,5-Timetacarb	0.01
3-Hydroycarbofuran	0.01
Acephate	0.01
Acetamiprid	0.01
Ametrine	0.01
Aminocarb	0.01
Atrazine	0.01
Azaconazole	0.01
Azinphos Methyl	0.01
Azoxystrobin	0.01
Bendiocarb	0.01
Bitertanol	0.01
Bromacil	0.05
Butafenacil	0.01
Carbaril	0.01
Carbendazime	0.01

ANALYTE	LO (mg/kg)
Carbofuran	0.01
Chloridazon	0.01
Cyanazine	0.01
Cyazofamid	0.01
Cymoxanil	0.01
Ciprodinil	0.05
Climbazole	0.01
Clomazone	0.01
Chlorfluazuron	0.05
Chlortoluron	0.01
Clothianidine	0.01
Desmethyl-pirimicarb	0.01
Desmetryn	0.01
Dicrotophos	0.01
Diphenoconazole	0.05
Diflubenzuron	0.01
Dimethoate	0.01
Dimethomorph	0.01
Dimoxystrobin	0.01
Diuron	0.01
Epoxyconazole	0.01
Etaconazole	0.01
Fenamiphos-sulfone	0.01
Fenbuconazole	0.01
Phenmedipham	0.01
Fenoxycarb	0.05
Flonicamid	0.01
Flubendamide	0.01
Fludioxonyl	0.01
Flusilazole	0.05
Fluthiacet-methyl	0.01
Flutriafol	0.01
Formotion	0.01
Phospfamidon	0.01
Fosmet	0.05
Fuberidazole	0.01
Imidadoprid	0.01
Iprobenfos	0.01
Iprodiona	0.05
Iprovalicarb	0.01

ANALYTE	LQ (mg/kg)
Isocarbophos	0.01
Isoprocarb	0.01
Isoproturon	0.01
Isoxaben	0.01
Lenacilo	0.01
Linuron	0.01
Malaoxon	0.01
Mandipropamid	0.01
Mecarbam	0.01
Mepampirima	0.01
Mepionyl	0.01
Metabenzthiazuron	0.01
Methamidophos	0.01
Metamitron	0.01
Motiocarb	0.01
Methiocarb sulfone	0.01
Methiocarb sulfoxide	0.01
Methobromuron	0.01
Metolcarb	0.01
Metomilo	0.01
Metoxifenozida	0.01
Metoxuron	0.01
Metribuzina	0.01
Myclobutanil	0.01
Monochrotophos	0.01
Neburon	0.01
Nitenpyram	0.01
Omethoate	0.01
Oxamil	0.01
Paclobutrazol	0.01
Paraoxon	0.01
Paraoxon-methyl	0.01
Pencicuron	0.01
Pyraclostrobin	0.01
Pyrifenox	0.05
Pyrifenox 1	0.01
Pyrimethanil	0.01
Pirimicarb	0.01
Promecarb	0.01
Prometrin	0.01

ANALYTE	LQ (mg/kg)
Propoxur	0.01
Rotenone	0.01
Siltiofam	0.01
Spirotetramat	0.01
Tebufenozide	0.01
Teflubenzuron	0.01
Terbumeton	0.01
Terbutrina	0.01
Tatraconazole	0.01
Tiadoprid	0.01
Thiamethoxam	0.01
Thiodicarb	0.01
Thiophanate-methyl	0.01
Thiofanox sulfoxide	0.01
Triadimefon	0.01
Triadimenol	0.01
T riazofos	0.01
Tricyclazole	0.01
Trifloxystrobin	0.01
Triticonazole	0.01
Vamidotion	0.01
Zoxamide	0.01

The uncertainty in the quantification limit of each pesticide was determined.