Analysis of 136 pesticides in avocado using a modified QuEChERS method with LC-MS/MS and GC-MS/MS*

UCT Part Numbers:
ECMSSA50CT-MP (6 g of $MgSO_4$ and 1.5 g anhydrous sodium acetate)
CUMPSC18CT (2 mL dispersive cleanup tubes containing 150 mg of anhydrous $MgSO_4$, 50 mg of PSA, and 50 mg endcapped C-18)

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Summary

A simple, high-throughput modified QuEChERS screening method for the analysis of 136 pesticides in highly fat rich avocado is described. The average recoveries for 79 pesticides by LC-MS/MS at 10, 50, and 200 ng/g fortifying levels were 86% or better (with maximum RSD at 9.2%). GC-MS/MS analysis demonstrated 70% recovery or better (RSD < 18%) from 57 pesticides at the same spike levels.

Table of Pesticides Evaluated for this Method

	Name	Class
Fungicides	Pyrachlostrobin	Strobilurin
	Chlorothalonil	OC
	Pyrimethanil	Anilnopyrimidine
	Imazalil	Imidazole
	o-Phenylphenol	Phenol
	Procymidone	Dicarboximide
	Tebuconazole	Triazole
	Thiabendazole	Benzimidazole
	Tolyfluanid	N-Trihalomethylthio
	Hexachlorobenzene	OC
Insecticides	Bifenthrin	Pyrethroid
	Aminocarb	Carbamate
	Chlorpyrifos	Pyridine OP
	Chlorpyrifos-methyl	Pyridine OP
	Diclorvos	OP
	DDT	OC
	DDE	OC
	Endosulfan	OC
	Ethion	OP
	Methamidophos	OP
	Acephate	OP
	Permethrin	Pyrethroid
	Acetamiprid	Neonicotinoid
Herbicides	Prometryn	Triazine
	Linuron	Phenylurea
	Trifluralin	Dinitroaniline

OC=organochlorine OP=organophosphate

Procedure

1. Sample Preparation

a) Add 3 g of homogenized sample to a 50 mL centrifuge tube
b) Add fortification and/or internal standards
c) Add 5 mL of reagent water and 25 mL of 1% acetic acid in acetonitrile (MeCN) to each sample tube
d) Cap tube and shake for 10 minutes with an SPEX 2000 Geno grinder (or equivalent) @ 1000 stroke/min
e) Add one **ECMSSA50CT** packet to each sample tube and shake for additional 10 min @ 1000 strokes/min
f) Centrifuge @ 3000 rpm for 10 min

2. Sample Clean-up for LC

a) Transfer 1 mL of supernatant to an autosampler vial
b) Sample is ready for LC-MS/MS analysis *(if sample clean-up is desired, see Sample Clean-up for GC below)*

3. Sample Clean-up for GC

a) Pipette 1 mL of supernatant into **CUMPSC18CT** tube
b) Vortex for 1 min
c) Centrifuge @ 2000 rpm for 10 min
d) Sample is ready for GC analysis

Note: Extract a clean matrix and clean-up with the steps above. This extract must be used to prepare matrix-matched calibration standards. Matrix-matching is necessary for this procedure.

LC-MS/MS Parameters
(Equivalent instrumentation may be used)

HPLC Conditions
LC: Shimadzu with two LC 20AD pumps
MS: 4000 Q-TRAP mass spectrometer AB Sciex
Autosampler: Sil-20AC autosampler
Column: Ultra Aqueous C18 column (3 µm, 100 x 2.1 mm) Restek
Guard Column: (10 x 2.1 mm) Restek
Column Oven: CTO-20AC column oven (Shimadzu)
Separation Temp: 50 °C
Software: Analyst software version 1.4
Mobile Phase: **A** 4 mM ammonium formate and 0.1% formic acid in water, **B** 4 mM ammonium formate and 0.1% formic acid in methanol
Mobile Phase Program: Gradient start at 5% B (0.0 - 0.4 min); flow rate of 0.5 mL/min. 60% B at 5 min, then 95% B at 12.5 min, hold until 14.5 min, and concluded by column equilibration at initial condition for 3 min. Total run time18 min.
Injection Volume: 1.0 µL
MS/MS Conditions
Electrospray: positive ion
Ion Transition: 60 sec each analyte
Curtain gas (CUR): 30 psi
Ion Spray V: 4500 volts
Nebulizer Gas (GSI): 60 psi
Heater Gas (GS2) 60 psi
Source Temp (TEM): 350 °C

GC/MS Parameters
(Equivalent instrumentation may be used)

GC Conditions
GC: Agilent 7890A GC,
MS: 7000 triple-quadrupole MS, MassHunter software (version B.05.00412)
Autosampler: 7693 autosampler
Column: two HP-5ms Ultra Inert capillary columns from Agilent (0.25 mm ID x 15m, 0.25 µm film thickness) connected at backflush union
Column Head Pressure: 12.772 psi
Oven Temperature: initial 60° C for 1 min, 40°/min to 170° C , then 10°/min to 310° C. Hold 1.2 min. Total run time 19 min.
Column Flow Rate: 1.335 mL/min He
Injector: 60° C for 0.2 min, ramp to 280° C @ 600° C/min
Autosampler: TriPlus Thermo Fisher Scientific
Back Flush: column 1 for 2 minutes at 310°
Injection Volume: 1.0 µL splitless mode
MS Parameters
Ion Source & Transfer Temp: 300 °C
Electron Multiplier V: 1400 V by auto tune
Collision gas: He & N_2 @ 1.5 and 2.25 mTorr, respectively

Retention Time (RT) and MRM Conditions for LC-MS/MS Analysis

Compound dependent parameters:
DP = declustering potential, CE = collision energy, EP = entrance potential, CXP = collision cell exit potential

Q1	Q3	RT (min)	Analyte	DP	EP	CE	CXP
184.1	143	2.4	**Acephate. 1**	61	10	13	4
184.1	49	2.4	**Acephate. 2**	61	10	33	4
223	126	5.2	**Acetamiprid. 1**	61	10	29	12
223	99	5.2	**Acetamiprid. 2**	61	10	53	18
228.1	186.1	7	**Ametryn. 1**	71	10	21	4
228.1	96	7	**Ametryn 2**	71	10	35	4
209.1	152	3.1	**Aminocarb.1**	71	10	21	8
209.1	137.1	3.1	**Aminocarb.2**	71	10	35	10
318	160.1	7.1	**Azinphos-methyl**	41	10	13	10
318	132	7.1	**Azinphos-methyl**	41	10	21	10
224.1	109	5.8	**Bendiocarb 1**	61	10	27	20
224.1	167.1	5.8	**Bendiocarb 2**	61	10	15	12
440.1	181.2	13.6	**Bifenthrin 1**	51	10	39	14
440.1	166.1	13.6	**Bifenthrin 2**	51	10	65	10
343	307	7.8	**Boscalid.1**	91	10	27	4
343	140	7.8	**Boscalid.2**	91	10	27	4
197	117.2	4.4	**Chlordimeform**	81	10	41	18
197	89	4.4	**Chlordimeform**	81	10	71	14
350	198	12.3	**Chlorpyriphos**	56	10	25	10
350	97	12.3	**Chlorpyriphos**	56	10	47	10
362.8	227	10.2	**Coumaphos**	71	10	37	12
362.8	306.9	10.2	**Coumaphos**	71	10	25	18
241.1	214.2	5.7	**Cyanazine**	66	10	27	18
241.1	104.1	5.7	**Cyanazine**	66	10	47	4
199.1	89.1	7.3	**Cycluron**	50	10	21	4
199.1	89	7.3	**Cycluron**	50	10	21	4
292	70	8	**Cyproconazole A1**	66	10	39	12
292	125	8	**Cyproconazole A2**	66	10	45	8
292.1	70.1	8.4	**Cyproconazole B1**	66	10	39	12
292.1	125.1	8.4	**Cyproconazole B2**	66	10	45	8
318.1	182	6.7	**Desmedipham.1**	41	10	19	12
318.1	136	6.7	**Desmedipham.2**	41	10	33	10
305	169.1	9.9	**Diazinon**	86	10	31	10
305	153.1	9.9	**Diazinon**	86	10	29	8
350	123	8.3	**Dichlorfluanid 1**	21	10	41	10
350	224	8.3	**Dichlorfluanid 2**	21	10	21	10
220.8	127.1	5.9	**Dichlorvos**	71	10	27	22

220.8	109.1	5.9	**Dichlorvos**	71	10	25	18
238.1	112.1	4.6	**Dicrotophos.1**	66	10	19	8
238.1	193	4.6	**Dicrotophos.2**	66	10	15	14
406.1	251.1	11.6	**Difenoconazole 1**	81	10	37	16
408.2	253.1	11.6	**Difenoconazole 2**	76	10	33	4
230	199	4.6	**Dimethoate.1**	50	10	14	15
230	125	4.6	**Dimethoate.2**	50	10	27	8
388.1	301	8.1	**Dimethomorph A1**	66	10	25	4
388.1	165.1	8.1	**Dimethomorph A2**	66	10	45	4
388.2	301.1	8.4	**Dimethomorph B1**	66	10	25	4
388.2	165.2	8.4	**Dimethomorph B2**	66	10	45	4
224.1	167	4.7	**Dioxacarb.1**	51	10	13	10
224.1	123	4.7	**Dioxacarb.2**	51	10	23	24
330	121.1	9.5	**Epoxiconazole. 1**	66	10	29	10
330	101.1	9.5	**Epoxiconazole. 2**	66	10	69	18
162	119	8.4	**Ethiolate. 1**	106	10	23	20
162	120.1	8.4	**Ethiolate. 2**	106	10	19	20
384.8	199.2	12	**Ethion. 1**	51	10	15	18
384.8	142.9	12	**Ethion. 2**	51	10	39	24
287.1	121.1	7.1	**Ethofumesate. 1**	81	10	23	8
287.1	259.1	7.1	**Ethofumesate. 2**	81	10	15	16
394.2	177.3	13.6	**Etofenprox NH_4 +1**	46	10	21	12
394.2	107.2	13.6	**Etofenprox NH_4 +2**	46	10	61	18
337	124.9	9.4	**Fenbuconazole.1**	81	10	41	8
337	70	9.4	**Fenbuconazole.2**	81	10	39	12
302.1	88	9.2	**Fenoxycarb.1**	66	10	31	6
302.1	116.1	9.2	**Fenoxycarb.2**	66	10	17	8
304	147	7.2	**Fenpropimorph.1**	66	10	39	4
304	117	7.2	**Fenpropimorph.2**	66	10	71	4
266	229	7.6	**Fludioxinil.1**	41	10	23	14
266	227.1	7.6	**Fludioxinil.2**	41	10	13	14
376	307	8.5	**Fluquinconazole.1**	71	10	33	4
376	349	8.5	**Fluquinconazole.2**	71	10	25	4
324.1	262.1	7.5	**Flutolanil.1**	76	10	27	16
324.1	242.1	7.5	**Flutolanil.2**	76	10	37	14
314.1	70	10.3	**Hexaconazole.1**	56	10	41	12
314.1	159	10.3	**Hexaconazole.2**	56	10	41	14
297	159	6.5	**Imazalil.1**	66	10	33	14
297	201	6.5	**Imazalil.2**	66	10	27	12
249.1	160	7.7	**Linuron.1**	61	10	23	4
249.1	182.1	7.7	**Linuron.2**	61	10	21	4
331	127.1	7.5	**Malathion. 1**	46	10	17	10

331	99.1	7.5	**Malathion. 2**	46	10	31	10
142	94	1.7	**Methamidophos.1**	55	10	20	4
142	125	1.7	**Methamidophos.2**	55	10	19	8
284.2	252.2	8.7	**Metolachlor. 1**	56	10	21	10
284.2	176.2	8.7	**Metolachlor. 2**	56	10	33	10
166.2	109.1	5.6	**Metolcarb. 1**	36	10	15	10
166.2	94.2	5.6	**Metolcarb. 2**	36	10	37	10
225.1	127.1	4.7	**Mevinphos-E.1**	55	10	20	8
225.1	193.2	4.7	**Mevinphos-E.2**	55	10	10	13
225	127	5.2	**Mevinphos-Z.1**	55	10	20	8
225	193.1	5.2	**Mevinphos-Z.2**	55	10	10	13
224.1	127.1	4.1	**Monocrotophos.1**	51	10	23	12
224.1	98	4.1	**Monocrotophos.2**	51	10	17	4
215.1	126.1	6.4	**Monolinuron.1**	51	10	23	4
215.1	99	6.4	**Monolinuron.2**	51	10	41	4
289	70	8.3	**Myclobutanil.1**	71	10	37	12
289	125	8.3	**Myclobutanil.2**	71	10	47	8
315	252.1	7.4	**Nuarimol.1**	81	10	31	16
315	81	7.4	**Nuarimol.2**	81	10	45	14
214	124.9	3	**Omethoate.1**	46	10	29	4
214	182.8	3	**Omethoate.2**	46	10	17	4
284.1	159	10.4	**Penconazole.1**	71	10	39	10
284.1	70	10.4	**Penconazole.2**	71	10	37	12
318	160	7.1	**Phosmet.1**	51	10	19	10
318	133	7.1	**Phosmet.2**	51	10	49	10
356.2	177.2	12.1	**Piperonyl butoxide 1**	51	10	19	10
356.2	119.1	12.1	**Piperonyl butoxide 2**	51	10	51	8
239.2	72.1	5.9	**Pirimicarb.1**	66	10	35	12
239.2	182.1	5.9	**Pirimicarb.2**	66	10	23	12
376	308	10.9	**Prochloraz.1**	46	10	17	10
376	70	10.9	**Prochloraz.2**	46	10	45	12
242.2	158.1	7.8	**Prometryn.1**	71	10	35	4
242.2	200.1	7.8	**Prometryn.2**	71	10	19	4
212.2	169.9	6.6	**Propachlor. 1**	66	10	23	30
212.2	93.9	6.6	**Propachlor. 2**	66	10	39	16
368.2	231.1	12.6	**Propargite.1**	46	10	15	14
368.2	175.1	12.6	**Propargite.2**	46	10	23	12
342.1	159	10.6	**Propiconazole.1**	61	10	39	10
342.1	69	10.6	**Propiconazole.2**	61	10	37	12
210.1	111	5.8	**Propoxur.1**	39	10	19	6
210.1	168.1	5.8	**Propoxur.2**	39	10	11	11
218.1	125	6	**Pyracarbolid.1**	61	10	27	8

218.1	97	6	**Pyracarbolid.2**	61	10	41	18
388	194	10.5	**Pyraclostrobin.1**	31	10	19	4
388	163	10.5	**Pyraclostrobin.2**	31	10	29	4
365	147	13.3	**Pyridaben.1**	46	10	31	4
365	309	13.3	**Pyridaben.2**	46	10	19	4
200	107	7.7	**Pyrimethanil.1**	71	10	33	4
200	82	7.7	**Pyrimethanil.2**	71	10	35	4
308.1	162.1	12.9	**Quinoxyfen.1**	81	10	65	10
308.1	197.1	12.9	**Quinoxyfen.2**	81	10	45	12
226.2	170.1	6.5	**Secbumeton.1**	50	10	35	4
226.2	100	6.5	**Secbumeton.2**	50	10	35	4
298.2	144.2	7.9	**Spiroxamine.1**	76	10	29	12
298.2	100.1	7.9	**Spiroxamine.2**	76	10	47	18
323	115	8.9	**Sulfotep. 1**	46	10	39	10
323	97.1	8.9	**Sulfotep. 2**	46	10	45	10
308.2	70	9.9	**Tebuconazole.1**	81	10	49	12
308.2	125	9.9	**Tebuconazole.2**	81	10	51	8
334	117	12.1	**Tebufenpyrad.1**	71	10	47	4
334	145	12.1	**Tebufenpyrad.2**	71	10	37	4
230.3	174.2	7.7	**Terbutylazine 1**	41	10	27	10
230.3	68	7.7	**Terbutylazine 2**	41	10	59	10
372.1	159	8.8	**Tetraconazole.1**	76	10	45	10
372.1	70	8.8	**Tetraconazole.2**	76	10	47	12
202.1	175.1	4.9	**Thiabendazole.1**	85	10	35	12
202.1	131.2	4.9	**Thiabendazole.2**	85	10	45	8
364	237.9	9.5	**Tolyfluanid.1**	6	10	19	10
364	137.1	9.5	**Tolufluanid.2**	6	10	37	10
294	197.1	7.8	**Triadimefon.1**	66	10	23	14
294	225	7.8	**Triadimefon.2**	66	10	19	8
296.1	70	8	**Triadimenol.1**	46	10	31	12
296.1	227.1	8	**Triadimenol.2**	46	10	19	14
314	162	8.3	**Triazophos 1**	56	10	25	10
314	119	8.3	**Triazophos 2**	56	10	49	10
190	163	5.8	**Tricyclazole 1**	81	10	33	10
190	136	5.8	**Tricyclazole 2**	81	10	41	12
409	186	11.2	**Trifloxystrobin. 1**	31	10	23	4
409	206	11.2	**Trifloxystrobin. 2**	31	10	21	4
346.1	278.1	11.7	**Triflumizole. 1**	51	10	15	8
346.1	73	11.7	**Triflumizole. 2**	51	10	27	6
346.1	278.1	11.8	**Triflumizole. 1**	51	10	15	8
346.1	73	11.8	**Triflumizole. 2**	51	10	27	6

GC-MS/MS Conditions for GC-amenable Pesticides

Analyte	Precursor 1	Product 1	Collision Energy	Precursor 2	Product 2	Collision Energy	RT (min)
Amitraz	293.1	162	6	293.1	132	25	14.77
Benfluralin	292	160	22	292	206	12	7.29
BHC-alpha	219	183	7	181	145	15	7.64
BHC-beta	219	183	8	217	181	7	8.03
BHC-delta	219	183	8	217	181	7	8.51
BHC-gamma	219	183	8	217	181	7	8.04
Bromopropylate	338.9	182.9	18	342.9	184.9	18	13.89
Cadusafos	159	97	24	158	81	15	7.44
Chlorothalonil	265.9	133	53	265.9	169.9	28	8.59
Chlorpyrifos-methyl	285.9	93	24	285.9	208	15	9.13
Cypermethrin	181	152	30	163	127	4	16.56
Dacthal	298.9	164.9	54	300.9	222.9	30	10.04
DEF	202	147	2	202	113	18	11.57
Dieldrin	262.9	192.9	40	262.9	190.9	38	11.7
Dinitramine	261	195	23	261	241	10	8.4
Endosulfan Sulfate	271.9	236.9	15	271.9	116.9	48	13
Endosulfan-I	240.9	205.9	15	195	159	8	11.25
Endosulfan-II	195	159	8	240.9	205.9	15	12.25
Endrin	262.9	192.9	40	262.9	190.9	38	12.1
EPN	157	110	14	185	110.1	25	13.92
Etridiazole	210.9	182.9	9	210.9	139.9	26	5.87
Fenarimol	219	107	12	251	139	15	15.06
Fenvalerate 1	167	125	12	125	89	23	17.38
Fenvalerate 2	167	125	12	125	89	23	17.58
Fluvalinate 1	250	55	18	250	200	24	17.55
Fluvalinate 2	250	55	18	250	200	24	17.6
Heptachlor	352.8	262.8	15	352.8	281.9	18	10.6
Hexachlorobenzene	283.9	213.9	40	283.8	248.9	22	7.78
L-Cyhalothrin	197	141	13	181	152	29	14.85
Iprodione	314	56	24	314	245	10	13.68
Methyl Parathion	263	109	12	263	79	32	9.13
MGK-264	164	80	32	164	98	12	10.42
Napropamide	271.1	72	15	271.1	128	2	11.39
o,p'-DDT	235	165	30	235	199	18	12.42
o,p'-Methoxychlor	227	121	15	121	78	26	13.19
o-phenylphenol	170	115.1	45	170	141	30	6.27
Oxadixyl	163	132	10	163	117	30	12.42
p,p'-DDE	246	176	35	318	246	25	11.6
p,p'-DDT	235	165	30	235	199	18	13.01

Parathion	291	109	10	291	81	35	9.96
Pentachloroaniline	262.9	191.9	25	264.9	193.9	28	8.91
Pentachlorobenzene	249.9	214.9	21	249.9	141.9	50	6.38
Permethrin-cis	183	153	18	183	115	30	15.62
Permethrin-trans	183	153	18	183	115	30	15.74
Phosalone	182	75	36	182	111	17	14.56
Pirimiphos-methyl	290	125	24	290	233	10	9.58
Procymidone	283	96	10	283	67	37	10.83
Profenofos	336.9	266.9	14	336.9	188	32	11.53
Pronamide	173	74	50	173	109	30	8.18
Propanil	161	99	30	217	161	7	8.93
Pyriproxifen	136	41.1	18	136	78.1	32	14.6
Quinalphos	157	102	28	146	118	10	10.72
Tetradifon	353.9	159	12	353.9	227	9	14.39
Tolclofos-methyl	265	93	26	265	109	52	9.22
Triallate	268	183.9	20	268	226	12	8.56
Trifluralin	306	264	7	306	160	25	7.25
Vinclozolin	212	172	16	187	124	22	9.1

Average Recovery and RSD of 79 Pesticides Spiked in Avocado at Three Concentrations via LC-MS/MS Analysis

	10 ng/g spike level N=5		50 ng/g spike level N=5		200 ng/g spike level N=5	
Analyte	**Recovery %**	**RSD %**	**Recovery %**	**RSD %**	**Recovery %**	**RSD %**
Acephate	104.9	5.0	82.6	11.8	92.6	6.3
Acetamiprid	102.7	6.7	84.6	8.9	96.4	3.9
Ametryn	99.8	3.9	84.3	11.4	91.4	6.1
Aminocarb	104.4	2.4	83.9	10.3	93.4	5.3
Azinphos-methyl	115.0	7.3	87.7	11.1	98.3	5.6
Bifenthrin	104.7	6.1	85.1	10.7	93.9	8.8
Boscalid	121.6	7.1	105.6	14.3	85.7	6.0
Chlordimeform	120.2	6.7	88.5	15.9	95.2	3.9
Chlorpyrifos	102.3	9.3	86.7	12.7	91.9	4.4
Coumaphos	99.0	5.7	81.9	11.2	91.8	4.4
Cyanazine	115.0	2.9	87.1	13.2	87.1	13.2
Cycluron	121.0	4.6	91.9	10.9	103.0	3.8
Cyproconazole A	140.0	9.2	86.7	14.3	93.9	6.0
Cyproconazole B	116.6	8.3	115.2	34.6	102.5	5.1
Desmedipham	110.8	5.9	108.3	29.9	103.4	6.8
Diazinon	112.0	3.7	87.1	11.7	95.3	4.7
Dichlorfluanid	99.8	9.1	84.1	11.0	92.3	4.6
Dichlorvos	83.2	18.8	77.2	9.3	86.8	4.0
Dicrotophos	80.8	14.8	74.7	5.7	93.8	9.5

Difenoconazole	103.6	3.2	84.1	11.9	92.6	5.2
Dimethoate	111.6	5.1	87.3	12.6	100.3	6.9
Dimethomorph A	103.3	4.6	83.9	12.3	92.8	4.2
Dimethomorph B	97.1	5.3	90.3	9.3	98.1	4.9
Dioxacarb	116.0	8.6	86.6	9.5	100.6	5.1
Epoxiconazole	97.2	4.0	83.5	12.1	92.9	5.3
Ethiolate	107.5	4.9	86.5	11.6	98.7	6.8
Ethion	102.0	8.3	88.8	15.8	94.0	8.7
Ethofumesate	98.3	6.5	83.3	11.4	92.4	5.5
Fenbuconazole	107.4	16.9	84.3	14.2	96.3	6.6
Fenoxycarb	104.1	14.4	92.0	12.3	102.3	7.2
Fenpropimorph	105.0	7.1	82.1	11.2	94.1	4.9
Fludioxinil	110.6	8.4	82.0	11.7	92.0	6.2
Fluquinconazole	118.0	13.6	83.9	16.9	102.5	8.9
Flutolanil	146.2	7.5	90.4	18.0	97.6	5.1
Hexaconazole	109.0	4.9	85.8	13.7	93.3	3.5
Imazalil	117.0	4.2	88.4	14.6	100.9	9.5
Linuron	123.4	8.6	94.5	13.9	97.7	6.3
Malathion	103.2	12.4	87.4	14.2	97.1	5.3
Methamidophos	113.0	2.3	83.1	15.9	93.3	7.7
Metolachlor	102.5	2.5	81.7	11.3	94.4	6.3
Metolcarb	100.1	5.9	83.3	13.3	93.5	4.6
Mevinphos-E	108.1	8.2	84.1	11.0	90.4	3.1
Mevinphos-Z	99.6	14.7	83.9	9.3	91.1	4.8
Monocrotophos	97.0	3.3	82.5	8.7	90.4	4.5
Monolinuron	105.0	4.8	85.1	11.8	93.1	5.4
Myclobutanil	110.4	3.1	87.0	11.6	93.0	4.5
Nuarimol	111.2	12.6	91.8	7.8	96.5	4.5
Omethoate	137.0	15.4	83.8	10.9	98.6	7.3
Penconazole	113.4	7.9	88.4	13.6	96.4	5.8
Phosmet Piperonyl	104.8	3.1	85.4	8.3	96.0	6.4
butoxide	106.0	4.1	83.0	10.4	91.5	6.6
Pirimicarb	104.3	2.9	84.5	11.1	93.0	5.6
Prochloraz	124.2	29.9	83.9	10.7	92.6	5.8
Prometryn	101.0	8.5	85.6	10.4	95.7	5.4
Propachlor	101.0	4.5	81.2	12.6	92.2	5.5
Propargite	109.2	6.7	84.2	7.0	91.8	5.5
Propiconazole	106.2	7.1	85.0	13.2	97.3	9.7
Propoxur	97.0	5.1	83.8	10.3	92.4	4.2
Pyracarbolid	101.3	3.2	82.9	13.4	93.0	5.7
Pyraclostrobin	109.6	7.6	83.8	10.9	93.0	5.3
Pyridaben	95.2	7.1	78.6	10.2	85.8	5.5
Pyrimethanil	107.0	15.4	91.2	12.0	93.3	6.5
Quinoxyfen	105.6	6.5	84.6	9.3	92.0	3.1

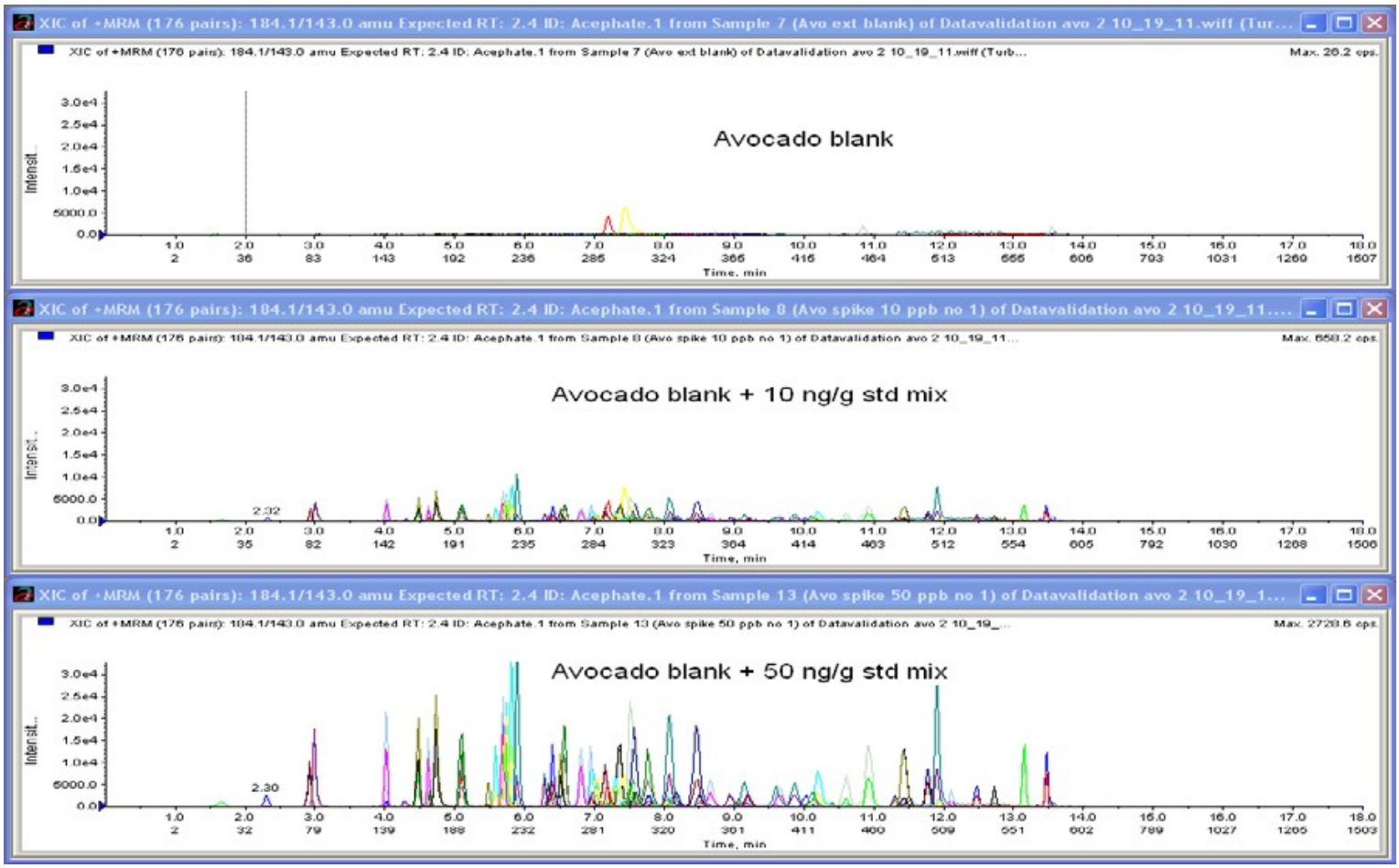
Secbumeton	103.8	5.8	82.2	8.7	92.7	5.1
Spiroxamine	104.6	4.3	83.4	12.6	94.5	6.1
Sulfotep	108.2	7.7	84.7	11.8	91.7	5.6
Tebuconazole	110.6	5.9	88.2	9.8	102.7	9.6
Tebufenpyrad	106.8	10.9	81.9	11.6	95.3	5.9
Terbutylazine	101.4	5.9	84.0	8.8	93.4	4.3
Tetraconazole	112.4	10.7	89.4	5.6	104.0	5.9
Thiabendazole	110.6	4.2	84.9	10.2	94.4	7.3
Tolyfluanid	129.6	4.2	86.7	9.6	89.8	6.0
Triadimefon	95.9	16.4	86.8	7.0	99.9	6.1
Triazophos	102.9	25.3	89.1	7.7	102.9	6.6
Tricyclazole	104.3	4.5	84.0	9.1	93.3	4.2
Trifloxystrobin	96.8	4.2	82.7	10.6	90.9	5.9
Triflumizole	101.5	5.7	84.0	11.1	92.1	4.7
Average	**107.1**		**86.1**		**94.8**	
Std. Dev	**9.9**		**5.8**		**4.0**	
RSD %	**9.2**		**6.7**		**4.2**	

Average Recovery and RSD of 57 Pesticides Spiked in Avocado at Three Concentrations with GC-MS/MS Analysis

Analyte	10 ng/g spike level N=5		50 ng/g spike level N=5		200 ng/g spike level N=5	
	Recovery %	RSD %	Recovery %	RSD %	Recovery %	RSD %
Amitraz	31.8	12.7	38.3	18.0	58.0	7.2
Benfluralin	81.3	9.4	68.5	12.5	91.3	4.8
BHC-alpha	74.9	5.2	76.1	11.9	95.7	3.5
BHC-beta	93.4	12.2	73.2	20.4	103.5	2.7
BHC-delta	70.5	4.8	76.5	12.0	95.4	4.1
BHC-gamma	84.2	12.2	73.1	20.5	101.7	3.5
Bromopropylate	60.2	15.7	69.2	13.7	97.1	5.1
Cadusafos	69.8	3.4	68.8	11.4	92.0	3.1
Chlorothalonil	70.4	28.2	52.2	14.2	81.9	19.4
Chlorpyrifos-methyl	79.0	9.0	73.7	12.4	92.3	7.5
Cypermethrin	130.7	11.0	104.2	10.3	92.3	5.9
Dacthal	70.1	7.5	71.1	14.5	90.2	3.4
DEF	57.1	18.9	61.6	11.0	94.2	6.6
Dieldrin	83.0	26.3	73.8	11.3	94.4	3.6
Dinitramine	92.2	6.5	77.7	12.0	95.2	4.6
Endosulfan Sulfate	106.9	14.2	69.2	22.4	106.2	5.8
Endosulfan-I	91.4	31.7	72.6	16.2	92.2	11.3
Endosulfan-II	78.2	7.3	70.6	9.2	100.0	5.9
Endrin	99.7	12.6	73.4	11.9	100.0	5.7

EPN	66.7	26.7	68.5	13.9	107.5	4.8
Etofenprox	82.8	8.9	78.8	11.6	89.0	4.8
Etridiazole	104.7	7.0	68.7	15.1	110.4	11.2
Fenarimol	63.2	7.7	65.8	15.3	96.9	6.6
Fenvalerate 1	72.2	27.7	76.9	14.3	102.9	7.7
Fenvalerate 2	75.4	20.2	63.9	22.5	92.3	3.9
Fluvalinate 1	58.4	31.4	65.0	17.9	99.6	5.2
Fluvalinate 2	51.5	37.4	57.5	27.5	81.7	11.9
Heptachlor	65.4	17.7	69.7	13.3	95.1	6.1
Hexachlorobenzene	60.6	9.1	61.6	11.9	81.0	6.1
L-Cyhalothrin	66.3	13.9	75.2	9.3	98.0	6.2
Iprodione	37.0	82.8	68.7	14.1	92.7	16.9
Methyl Parathion	75.0	14.1	77.0	13.8	95.6	5.2
MGK-264	74.1	10.1	70.8	11.7	97.7	2.0
Napropamide	74.4	10.2	74.7	15.4	103.7	4.9
o,p'-DDT	94.2	20.3	62.1	29.8	119.2	23.1
o,p'-Methoxychlor	80.5	12.3	84.9	18.5	112.0	15.3
o-phenylphenol	105.0	17.9	76.7	11.3	83.6	5.1
Oxadixyl	64.6	8.6	73.9	13.4	76.6	6.6
p,p'-DDE	61.5	7.4	67.2	14.3	89.0	4.7
p,p'-DDT	NA	NA	NA	NA	NA	NA
Parathion	58.5	14.6	66.4	13.3	94.2	4.6
Pentachloroaniline	71.3	5.0	70.0	11.7	89.9	3.8
Pentachlorobenzene	70.5	4.6	68.2	13.0	85.4	3.8
Permethrin-cis	89.9	12.5	62.1	13.8	93.6	4.8
Permethrin-trans	98.5	14.1	74.7	34.7	111.6	9.1
Phosalone	74.4	15.0	75.6	11.0	108.0	8.5
Pirimiphos-methyl	77.7	11.5	72.2	12.7	92.5	2.1
Procymidone	76.8	5.0	75.6	11.6	98.5	13.5
Profenofos	52.2	37.2	95.1	6.5	89.6	3.7
Pronamide	71.3	8.6	71.7	15.7	93.2	5.2
Propanil	72.4	9.0	72.2	13.8	96.1	6.4
Pyriproxifen	64.8	7.4	67.9	13.4	96.1	6.4
Quinalphos	79.5	15.8	67.5	13.4	91.1	5.0
Tetradifon	66.3	5.9	72.1	11.3	88.4	8.5
Tolclofos-methyl	81.6	3.7	75.4	10.9	94.5	3.7
Triallate	70.3	4.4	67.4	17.1	92.3	4.7
Trifluralin	63.9	9.2	70.8	10.4	95.5	5.7
Vinclozolin	71.5	11.0	70.6	9.8	101.3	6.5
Average	**73.9**		**70.2**		**94.3**	
Std. Dev	**15.0**		**7.9**		**17.0**	
RSD %	**20.3**		**11.3**		**18.0**	

Reconstructed LC-MS/MS Chromatogram of Avocado Blank, Avocado Blank Fortified at 10 ng/g, and Avocado Blank Spiked with 50 ng/g Standard Mix Sample Concentration is 0.12 G Sample/Ml Solvent With 1 µL Injection Volume



* Adapted from: 'Analysis of 136 Pesticides in Avocado Using a Modified QuEChERS Method with LC-MS/MS and GC-MS/MS'
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