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LCMS-8060NX

Application News

SGLC-LC/MS-082EN

Analysis of 331 Pesticides and Their Metabolites in Mango

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User Benefits

- Established an effective, fast and simple sample preparation method for analysis of pesticides in mango.
- Realized simultaneous quantitative analysis of multi pesticides and metabolites, such as organophosphates, organochlorines, pyrethroids, triazole, amides, triazines and carbamate esters.
- SHIMSEN QuEChERS provides precise amounts salts in sachet packs and SPE sorbents in centrifuge tube for enhanced laboratory efficiency and throughput.

■ Introduction

Pesticides are essential tools in agriculture for protecting crops from pests and diseases, but their presence in food products must be carefully monitored to ensure consumer safety. Mango, a common coloured fruit, are no exception. Pesticide residues in mango can pose potential health risks and impact the quality of the final products. Therefore, rigorous analysis methods are crucial to determine the levels of pesticide residues in mango and ensure compliance with regulatory standards. In this application, we present a complete workflow according to GB23200.121-2021, from sample preparation using SHIMSEN QuEChERS, to sample analysis using Shim-pack GIST C18-AQ column on Shimadzu LCMS-8060NX.

Table 1. LCMS conditions

UHPLC condition:	
LC system:	Shimadzu Nexera™ LC-40B X3
Column:	Shim-pack GIST C18-AQ, 1.9 µm, 100 × 2.1 mm *1
Column Temp.:	40 °C
Flow rate:	0.3 mL/min
Mobile phase A:	2mM ammonium formate in water containing 0.01% formic acid
Mobile phase B:	2mM ammonium formate in methanol containing 0.01% formic acid
Gradient program:	3% B (0 min) → 3%B (1 min) → 15% B (1.5 min) → 50% B (2.5 min) → 70% B (18 min) → 98% B (23 min) →98% B (27 min) →3% B (27.1 min) →3% B (30 min)
Injection volume:	2 µL (co-injection, 20 µL water)
MS conditions:	
Interface:	Heated ESI (Positive or Negative)
Interface temp:	300 °C
Collision gas:	Ar
Nebulizing gas:	N_2, 3 L/min
Heating gas flow:	Zero air, 10 L/min
DL temperature:	150 °C
Drying gas flow:	N_2, 10 L/min
Heat block temp:	400 °C
MS mode:	MRM

*1 P/N: 227-30807-02

■ Experimental

Materials:

SHIMSEN QuEChERS Extract Salt (P/N: 380-00149)
SHIMSEN QuEChERS II (P/N: 380-00990-13)
Filter and vial:
SHIMSEN Disc HPTFE syringe filter (P/N: 380-00341)
LabTotal Vial (P/N: 227-34001-01)

Sample Preparation:

10 g of homogenized sample in 50 mL centrifuge tube was added with 10 mL of acetonitrile followed by SHIMSEN QuEChERS extraction salt (4 g $MgSO_4$, 1 g NaCl, 0.5 g DHS, 1 g TSCD, P/N: 380-00149) and a single piece of ceramic homogenizer (P/N: 380-00171). The tube was shake vigorously for 1 min after which centrifuged for 5 minutes at 4200 rpm. 6 mL of the supernatant was transferred into SHIMSEN QuEChERS dSPE tube (30 mg PSA, 15mg GCB, 900 mg $MgSO_4$, P/N: 380-00990-13), vortex and mix for 1 min, centrifuged at 4200 rpm for 5 min, and filtered the supernatant through a 0.22 µm syringe filter for LC-MS/MS analysis. Figure 1 shows the simplified sample preparation workflow.

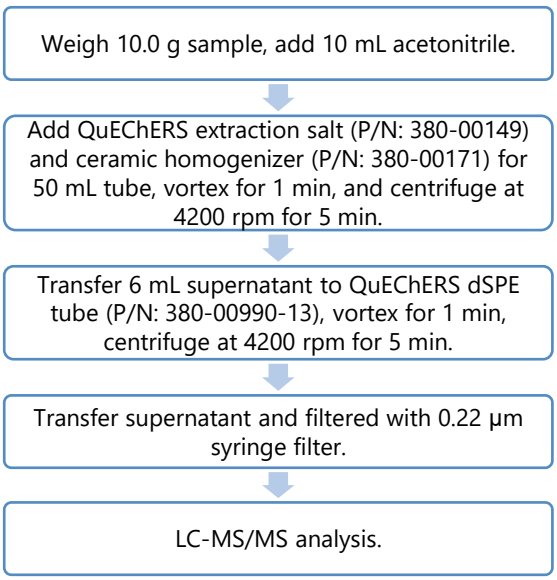

Figure 1. QuEChERS sample preparation workflow for mango.

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
1	methamidophos	+	142.1	94	-16	-15	-17	125.1	-16	-16	-23
2	acephate	+	184.2	143	-20	-8	-15	95	-20	-23	-16
3	omethoate	+	214.1	183	-23	-10	-19	155	-23	-14	-28
4	oxamyl oxime	+	163	72.1	-11	-12	-16	90	-11	-18	-20
5	dinotefuran	+	203.1	129.1	-22	-12	-22	113.1	-22	-10	-12
6	propamocarb	+	189.2	102.1	-30	-20	-23	144.1	-30	-12	-15
7	aldicarb sulfoxide	+	207	89	-13	-15	-19	132	-19	-10	-10
8	aldicarb sulfone	+	240.1	148	-15	-12	-29	166	-13	-11	-20
9	oxamyl	+	237.1	72	-12	-10	-15	90.1	-12	-8	-20
10	nitenpyram	+	271.1	126	-14	-26	-20	189.1	-14	-13	-19
11	oxydemeton-methyl	+	247	169	-30	-24	-30	105.1	-30	-20	-30
12	demeton-S-methyl-sulfone	+	263	169	-30	-24	-30	125	-30	-30	-26
13	methomyl	+	163.1	88	-18	-8	-16	106.1	-18	-10	-19
14	monocrotophos	+	224.1	193	-15	-9	-22	127.1	-18	-20	-15
15	thiamethoxam	+	292	211.1	-30	-20	-22	181.1	-30	-30	-19
16	flonicamid	+	230.1	203.1	-25	-10	-25	174.2	-11	-25	-19
17	chlordimeform	+	197.1	46.2	-21	-35	-19	117.3	-22	-40	-24
18	phosfolan-methyl	+	228	168	-11	-25	-13	109	-11	-15	-22
19	spirotetramat-enol-glucoside	+	464	302	-22	-16	-23	216	-22	-42	-16
20	dicrotophos	+	238	112.1	-12	-12	-11	193	-12	-9	-20
21	imidacloprid	+	256.1	209.1	-29	-14	-22	175.1	-29	-17	-18
22	flumetsulam	+	326.1	129.1	-12	-15	-25	109	-12	-51	-23
23	clothianidin	+	250	169.1	-29	-12	-17	132	-29	-14	-24
24	methiocarb sulfoxide	+	242.1	185.1	-30	-24	-19	122.1	-11	-40	-26
25	imidaclothiz	+	262.1	181.1	-13	-25	-14	122	-10	-40	-15
26	vamidothion	+	287.8	118.1	-14	-35	-22	146.1	-14	-26	-16
27	3-hydroxy carbofuran	+	238.1	163.1	-27	-14	-17	181.2	-27	-10	-19
28	acetamiprid	+	223.1	126.1	-30	-22	-30	56.1	-30	-15	-23
29	mevinphos	+	225	127.1	-25	-17	-23	193	-25	-8	-20
30	methiocarb sulfone	+	258.1	122.1	-13	-23	-24	201.1	-29	-8	-14
31	carbendazim	+	192.1	160.1	-30	-39	-30	132.1	-30	-40	-24
32	dimethoate	+	230	199	-26	-15	-21	125	-26	-30	-22
33	trichlorfon	+	257	109	-10	-34	-22	220.8	-29	-11	-24
34	demeton-S-sulfoxide	+	275.1	197	-10	-17	-15	141	-10	-30	-28
35	metamitron	+	203.1	175	-10	-18	-20	104	-10	-23	-22
36	diethyl aminoethyl hexanoate	+	216.2	143.3	-24	-25	-10	100.3	-24	-25	-23
37	sulfoxaflor	+	278.1	174.2	-21	-11	-19	154.1	-20	-26	-25
38	chloridazon	+	222	92.1	-25	-26	-16	77.1	-25	-36	-30
39	demeton-S-sulfone	+	291	234.8	-14	-15	-18	263	-11	-11	-20
40	thiacloprid	+	253	126.1	-28	-30	-22	99	-28	-43	-17
41	cymoxanil	+	199.1	128.1	-21	-8	-25	111.1	-21	-18	-21
42	florasulam	+	360.1	129.1	-24	-23	-23	109.1	-24	-54	-18
43	fensulfothion oxon	+	293.1	237	-11	-29	-18	265	-11	-23	-20
44	pirimicarb-desmethyl	+	225	72.1	-30	-42	-30	180.1	-30	-15	-30
45	thiabendazole	+	202	175.1	-30	-35	-30	131.1	-30	-25	-24

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
46	tricyclazole	+	190	163	-21	-21	-30	136	-21	-26	-24
47	fensulfothion oxon sulfone	+	309.1	175	-18	-20	-20	253	-15	-25	-20
48	phosfolan	+	256	228	-13	-12	-25	140	-13	-15	-26
49	aldicarb	+	207.9	116	-14	-6	-12	89	-15	-15	-18
50	phosmet oxon	+	302	160	-11	-40	-19	133	-11	-25	-16
51	oxadixyl	+	279.1	219.1	-30	-18	-23	133.1	-30	-30	-24
52	formothion	+	258	199	-23	-8	-16	125	-10	-23	-25
53	cinosulfuron	+	414.1	183.1	-20	-30	-19	157.1	-20	-15	-16
54	metolcarb	+	166.1	109.1	-18	-20	-20	107.1	-18	-15	-19
55	thifensulfuron-methyl	+	388.1	167.1	-19	-16	-18	141.1	-19	-22	-27
56	probenazole	+	224	41	-16	-42	-18	39	-11	-55	-17
57	phosphamidon	+	300	174.1	-15	-22	-17	127	-15	-40	-22
58	cyanazine	+	241.1	104	-30	-31	-19	68.1	-30	-39	-27
59	triasulfuron	+	402.1	167.1	-20	-18	-30	141.1	-20	-20	-26
60	phenamacril	+	217.1	104	-11	-40	-20	189.1	-11	-17	-22
61	metsulfuron-methyl	+	382.1	167.1	-14	-12	-13	199	-13	-20	-15
62	dichlorvos	+	238	109.1	-12	-21	-20	220.9	-12	-11	-15
63	thiophanate-methyl	+	343	151	-12	-19	-29	311	-12	-10	-17
64	thidiazuron	+	221.2	102	-15	-16	-18	128	-15	-17	-23
65	bendiocarb	+	224.1	167.1	-25	-15	-18	109.1	-25	-30	-20
66	spirotetramat-mono-hydroxy	+	304.1	254.1	-11	-18	-29	211	-15	-19	-16
67	propoxur	+	210.1	111.1	-23	-13	-20	168.1	-23	-7	-18
68	chlorsulfuron	+	358.1	141.1	-18	-17	-15	167	-17	-18	-30
69	carbofuran	+	222.1	123.1	-25	-30	-22	165.1	-25	-20	-17
70	fenamiphos sulfoxide	+	319.8	233	-30	-23	-26	292.1	-30	-16	-21
71	metribuzin	+	215.1	187.1	-25	-18	-18	84.1	-25	-21	-30
72	simazine	+	202.1	132	-30	-19	-25	124.1	-30	-17	-23
73	hexazinone	+	253.2	171.1	-30	-20	-18	85.1	-30	-31	-15
74	malaoxon	+	314.9	127	-15	-20	-23	99	-15	-45	-19
75	amidosulfuron	+	370.2	261.1	-13	-14	-27	218.1	-13	-23	-22
76	demeton-S-methyl	+	231	89	-21	-24	-19	61	-10	-21	-23
77	fenthion sulfoxide	+	295	280	-11	-25	-10	109	-11	-25	-20
78	fenamiphos sulfone	+	335.9	266	-16	-14	-29	188.1	-16	-35	-21
79	tebuthiuron	+	229.1	172.1	-30	-20	-30	116.1	-30	-25	-23
80	sulfentrazone	-	385	307.1	18	23	21	199	18	35	20
81	carbaryl	+	202.1	145.1	-22	-9	-26	127.1	-22	-27	-22
82	carboxin	+	236.1	143	-10	-22	-16	87	-10	-23	-19
83	ethirimol	+	210.2	140.1	-13	-22	-25	98.1	-13	-26	-16
84	fenthion sulfone	+	311	125	-11	-18	-15	233.1	-14	-23	-24

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
86	cyantraniliprole	+	475	286	-11	-19	-22	444	-17	-19	-24
87	pirimicarb	+	239.2	72.1	-30	-40	-30	182.2	-30	-19	-30
88	fosthiazate	+	284.1	104.1	-30	-21	-19	228	-30	-15	-24
89	spirotetramat-enol	+	302.1	216	-15	-27	-17	270	-11	-20	-15
90	disulfoton sulfoxide	+	291	185	-30	-20	-19	213	-30	-16	-23
91	chlortoluron	+	213.1	72	-10	-40	-16	46.1	-13	-25	-19
92	phorate sulfoxide	+	277	199	-10	-10	-15	96.9	-10	-34	-19
93	simetryn	+	214.2	96.2	-25	-24	-21	68.2	-24	-30	-27
94	mesosulfuron-methyl	+	504.1	182.1	-34	-25	-18	139	-34	-52	-26
95	methacrifos	+	240.8	209	-12	-10	-23	125	-12	-20	-24
96	disulfoton sulfone	+	306.8	96.9	-15	-20	-18	125	-15	-25	-23
97	tritosulfuron	+	446	195	-16	-20	-23	221	-21	-19	-12
98	phorate sulfone	+	293	171.1	-22	-9	-19	115	-22	-24	-20
99	isoprocarb	+	194.1	95	-21	-30	-17	137.1	-22	-15	-14
100	flutriafol	+	302.1	123	-15	-28	-22	109	-15	-31	-19
101	tribenuron-methyl	+	396.1	155	-19	-30	-30	181	-19	-30	-28
102	atrazine	+	216.1	174.1	-30	-17	-18	96.1	-30	-25	-17
103	imazalil	+	297	159	-15	-24	-15	201	-15	-18	-21
104	isoproturon	+	207.1	72	-23	-40	-28	165.1	-23	-20	-17
105	metazachlor	+	278.1	210.1	-30	-14	-22	134.1	-30	-35	-24
106	fensulfothion	+	309	281	-11	-15	-30	253	-11	-18	-26
107	propachlor	+	212.1	170	-30	-22	-18	94.1	-30	-20	-18
108	chlorpropham	+	214	172	-10	-10	-18	154	-18	-16	-14
109	orthosulfamuron	+	425	199.1	-30	-13	-21	227	-30	-15	-24
110	iodosulfuron-methyl-sodium	+	507.9	167	-20	-19	-19	83	-26	-53	-15
111	diuron	+	233	72	-14	-21	-15	46	-12	-16	-19
112	forchlorfenuron	+	248.1	129.1	-30	-17	-23	93.1	-30	-34	-17
113	isoxaflutole	+	360.1	251	-20	-19	-27	144	-23	-50	-30
114	metalaxyl	+	280.1	220.2	-30	-10	-24	192.2	-30	-25	-20
115	heptenophos	+	251	127	-28	-11	-25	109	-28	-29	-20
116	fensulfothion sulfone	+	325	191	-12	-23	-11	173	-21	-24	-19
117	clethodim sulfone	+	392.1	300	-11	-14	-22	164	-11	-26	-19
118	metazosulfuron	+	476.1	182	-17	-21	-21	295	-17	-16	-23
119	spirotetramat-keto-hydroxy	+	318	300	-12	-13	-23	214	-12	-25	-16
120	methidathion	+	303	145	-21	-8	-15	85.1	-21	-22	-30
121	flumorph	+	372.1	285.1	-17	-15	-29	165.2	-17	-23	-28
122	fenpropidin	+	274.1	147.1	-30	-35	-30	117.2	-14	-53	-21
123	clethodim sulfoxide	+	376.1	206	-18	-14	-16	164.1	-18	-23	-13

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
124	azinphos-methyl	+	318.1	132.1	-15	-14	-23	261	-15	-7	-28
125	phenmedipham	+	318.1	168	-11	-20	-19	136	-11	-35	-16
126	clomazone	+	240.1	125	-27	-10	-22	89.1	-27	-35	-16
127	phosmet	+	318	160	-16	-30	-17	133.2	-16	-35	-25
128	chlorantraniliprole	+	484	452.9	-24	-19	-30	285.9	-24	-16	-30
129	bensulfuron-methyl	+	411.1	149.2	-20	-14	-28	182.2	-20	-35	-19
130	demeton	+	259	89	-13	-9	-18	61	-10	-32	-13
131	pyriftalid	+	319	139	-22	-27	-25	179	-22	-31	-29
132	ametryn	+	228.1	186.1	-30	-25	-19	68.1	-30	-30	-27
133	flucetosulfuron	+	488	156	-25	-21	-28	273	-25	-26	-28
134	fenobucarb	+	208.1	95	-10	-30	-20	152	-18	-15	-12
135	linuron	+	249	160.1	-27	-17	-17	182.1	-28	-14	-19
136	saflufenacil	+	501.1	349	-20	-28	-23	459	-40	-15	-21
137	pyrimethanil	+	200.1	107	-30	-25	-19	168.1	-30	-29	-30
138	propanil	+	218	162	-24	-15	-17	127	-24	-26	-23
139	albendazole	+	266	234	-12	-30	-23	191	-12	-25	-30
140	terbufos sulfone	+	321	171	-22	-12	-17	115	-22	-26	-24
141	terbufos sulfoxide	+	305	186.9	-30	-20	-30	97	-30	-52	-10
142	ethofumesate	+	304.1	241.1	-20	-13	-13	259	-22	-16	-29
143	methiocarb	+	226.1	169.1	-25	-19	-18	121.1	-25	-25	-23
144	diethofencarb	+	268.1	226.1	-30	-15	-24	180.1	-30	-25	-19
145	flurtamone	+	334.1	247.1	-12	-35	-19	303	-12	-20	-23
146	azoxystrobin	+	404.1	372.1	-30	-25	-26	329	-30	-28	-23
147	fludioxonil	+	266.1	229	-10	-14	-18	158	-10	-46	-19
148	fenamidone	+	312.1	236.1	-11	-15	-24	92.1	-11	-24	-16
149	halosulfuron-methyl	+	435	182	-16	-21	-21	139	-10	-40	-16
150	pyrisoxazole	+	289.1	151.1	-11	-14	-18	120	-11	-20	-14
151	terbuthylazine	+	230.1	174.1	-10	-25	-20	104.1	-15	-25	-22
152	dimethenamid	+	276.1	244.1	-14	-23	-25	168.1	-14	-30	-17
153	promecarb	+	208.2	109.1	-22	-10	-19	151.1	-22	-15	-16
154	ethiprole	+	397	255	-20	-45	-26	351	-20	-15	-24
155	boscalid	+	343	307.1	-12	-18	-30	271.1	-12	-30	-26
156	chlorimuron-ethyl	+	415.1	186	-20	-20	-19	83.1	-20	-43	-15
157	propyzamide	+	256.1	190	-28	-13	-20	173	-28	-20	-18
158	paclobutrazol	+	294.1	70.1	-15	-21	-28	125.1	-15	-40	-22
159	dimethomorph	+	388.1	301	-19	-30	-21	165.1	-19	-25	-30
160	mandipropamid	+	412.1	328.1	-11	-10	-22	125	-11	-25	-20
161	isoprothiolane	+	291.1	231.1	-14	-20	-25	189.1	-14	-30	-20
162	flutolanil	+	324.1	262.1	-16	-25	-27	242	-16	-20	-25
163	molinate	+	188.1	126.1	-21	-13	-13	98.1	-20	-20	-18
164	fluxapyroxad	+	382	362.1	-11	-14	-25	342.1	-11	-21	-22
165	ethoxysulfuron	+	399.1	261	-20	-15	-29	218	-20	-26	-23
166	triflusulfuron-methyl	+	493.1	264.1	-18	-15	-29	96.1	-18	-54	-18

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
167	fluopicolide	+	382.9	173	-17	-22	-30	145	-17	-47	-24
168	malathion	+	331	127.1	-17	-12	-13	125	-12	-26	-25
169	mepronil	+	270.2	119.1	-30	-25	-30	228.1	-30	-18	-30
170	myclobutanil	+	289.1	70.1	-30	-21	-28	125.1	-30	-30	-22
171	triadimefon	+	294.1	69.2	-21	-22	-26	197.1	-21	-15	-21
172	propyrisulfuron	+	456	261	-17	-16	-28	196	-17	-15	-20
173	fenpropimorph	+	304.2	147.2	-30	-24	-27	119.1	-30	-30	-22
174	pyrazosulfuron-ethyl	+	415.1	182.1	-21	-18	-19	139.1	-21	-42	-24
175	bromuconazole	+	377.9	158.9	-19	-28	-30	70	-19	-23	-30
176	mefenacet	+	299.1	148.1	-15	-21	-15	120.1	-15	-40	-21
177	sedaxane	+	332	159	-13	-38	-28	292	-12	-15	-20
178	pyridaphenthion	+	341.1	189.1	-17	-15	-20	205.1	-23	-15	-22
179	methoxyfenozide	+	369.2	149.1	-18	-16	-16	313.1	-18	-8	-22
180	prometryn	+	242.2	158.1	-30	-15	-29	200.2	-30	-12	-22
181	triadimenol	+	296.1	70.1	-10	-21	-15	99.2	-14	-16	-20
182	cyproconazole	+	292.1	70.1	-30	-20	-27	125.1	-30	-30	-22
183	triazophos	+	314.1	162.2	-23	-35	-17	119.2	-23	-25	-21
184	fenpyrazamine	+	332	304	-16	-13	-17	272	-12	-13	-21
185	isazofos	+	316	164	-11	-16	-19	122	-11	-26	-10
186	procymidone	+	284	256	-23	-18	-27	67	-19	-44	-28
187	cyclosulfamuron	+	422.2	261	-30	-17	-27	218.1	-30	-28	-22
188	fenarimol	+	331	268.1	-16	-22	-28	259.1	-17	-26	-26
189	fluopyram	+	397	173	-28	-20	-18	207.9	-28	-15	-22
190	fenhexamid	+	301.9	97.1	-15	-23	-19	55.1	-15	-40	-22
191	iprovalicarb	+	321.2	119.1	-30	-19	-22	203.1	-30	-8	-22
192	triticonazole	+	318.1	70.1	-11	-21	-15	125.1	-11	-26	-25
193	tetraconazole	+	372	159.1	-27	-31	-29	70.2	-27	-24	-27
194	ethoprophos	+	243.1	131	-26	-20	-23	97	-27	-32	-17
195	spirotetramat	+	374	302	-14	-17	-23	330	-14	-15	-25
196	flufenacet	+	364	152.1	-19	-30	-15	194.1	-19	-16	-20
197	napropamide	+	272.2	129.2	-30	-16	-23	171.1	-30	-17	-18
198	acetochlor	+	270.1	224.1	-10	-8	-17	148.2	-16	-19	-18
199	chromafenozide	+	395.3	175.1	-14	-40	-20	339.2	-15	-7	-19
200	alachlor	+	270.1	238.1	-30	-10	-26	162.2	-30	-19	-30
201	epoxiconazole	+	330.1	121.2	-12	-20	-26	101	-12	-43	-21
202	cyazofamid	+	325	108.1	-11	-12	-21	261.1	-24	-11	-30
203	metolachlor	+	284.1	252.1	-30	-25	-27	176.2	-30	-20	-19
204	uniconazole	+	292.1	70.1	-21	-24	-27	125	-21	-28	-23
205	fenbuconazole	+	336.9	125.1	-26	-27	-25	70	-26	-20	-28
206	diflubenzuron	+	311	158	-11	-15	-30	141.2	-11	-24	-11
207	iprodione	+	330.1	245	-13	-16	-25	288	-25	-14	-20
208	fipronil desulfinyl	-	387	351	14	17	23	282	14	32	17
209	thifluzamide	+	528.8	148	-26	-38	-26	488.9	-34	-24	-21

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
210	fenothiocarb	+	254.1	72.1	-13	-10	-28	160.1	-13	-14	-16
211	picoxystrobin	+	368.1	205.1	-10	-13	-16	145	-18	-35	-29
212	rotenone	+	395.1	213.1	-14	-22	-23	192.1	-14	-22	-18
213	bupirimate	+	317.1	108	-30	-26	-19	210.2	-30	-23	-22
214	flusilazole	+	316.1	247.1	-30	-18	-27	165.1	-30	-29	-30
215	fenoxycarb	+	302.1	88.1	-15	-21	-16	116.1	-15	-10	-12
216	fenamiphos	+	304.1	217.1	-15	-15	-23	202	-15	-45	-21
217	parathion	+	292	236.2	-11	-15	-23	264	-11	-10	-26
218	cyprodinil	+	226.1	93.1	-30	-34	-16	108.1	-30	-27	-19
219	fenoxanil	+	329.1	302.1	-17	-12	-30	86.1	-17	-22	-15
220	quinalphos	+	299	163.1	-15	-20	-30	147.1	-15	-21	-27
221	dimoxystrobin	+	327	205.1	-30	-15	-30	116	-30	-35	-30
222	fipronil	-	435	330	10	16	21	250	10	28	24
223	tebufenozide	+	353.2	133.1	-18	-20	-24	297.1	-18	-8	-15
224	silthiofam	+	268.1	252	-10	-8	-26	73.1	-10	-27	-30
225	penconazole	+	284.1	70	-14	-17	-27	159	-14	-27	-30
226	penthiopyrad	+	360	276	-18	-11	-28	177	-27	-34	-17
227	chlorbenzuron	+	309	156	-21	-17	-18	111	-10	-45	-23
228	phenthoate	+	321	247	-23	-11	-17	79.1	-23	-41	-30
229	kresoxim-methyl	+	314.1	222.2	-16	-13	-24	235.1	-16	-15	-25
230	fluthiacet-methyl	+	404	274.1	-29	-30	-20	344.1	-29	-23	-26
231	diclobutrazol	+	328	70	-12	-21	-15	70	-12	-22	-15
232	pyrametostrobin	+	382.1	194.1	-14	-18	-15	163	-14	-15	-19
233	penflufen	+	318	141	-12	-20	-16	234	-12	-28	-18
234	iprobenfos	+	289.1	91.1	-30	-21	-16	205	-30	-10	-22
235	fenthion	+	279.2	169.1	-30	-17	-18	247.1	-30	-12	-18
236	etrimfos	+	293	265	-15	-16	-28	125	-15	-24	-23
237	carfentrazone-ethyl	+	429.1	412	-11	-11	-17	346	-15	-26	-29
238	tebuconazole	+	308.1	70.1	-11	-23	-15	125	-11	-31	-25
239	fipronil sulfide	-	419	262	16	29	16	383	12	13	17
240	fonofos	+	247.1	109	-27	-19	-19	137.1	-26	-10	-14
241	sulfotep	+	323	115	-16	-31	-20	171.1	-16	-15	-18
242	isofenphos-methyl	+	332.1	231	-23	-14	-25	121.1	-23	-33	-22
243	edifenphos	+	311	283	-24	-20	-30	111.1	-24	-35	-21
244	propisochlor	+	284.1	224.1	-20	-9	-24	73.1	-20	-12	-29
245	benzovindiflupyr	+	398	342	-15	-18	-23	378	-15	-14	-26
246	zoxamide	+	335.8	187	-16	-24	-20	159	-16	-41	-30
247	anilofos	+	368	199	-18	-20	-21	125	-18	-22	-22
248	propiconazole	+	342.1	159.1	-12	-25	-19	161	-12	-31	-19
249	hexaconazole	+	314.1	70.2	-15	-21	-28	159.2	-15	-29	-30
250	flubendiamide	-	681	254.1	32	26	27	273.8	32	15	28
251	diazinon	+	305	169.1	-30	-15	-18	153.1	-30	-20	-16
252	pyraflufen-ethyl	+	413	339	-20	-19	-19	253	-15	-34	-30

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
253	coumaphos	+	363	227	-18	-26	-23	307.1	-18	-18	-21
254	pyrimorph	+	385.2	242.1	-14	-27	-18	272.1	-14	-33	-21
255	benalaxyl	+	326.2	148.2	-16	-13	-15	294.1	-16	-15	-20
256	chlorfenvinphos	+	358.9	155.1	-18	-12	-30	99	-18	-33	-18
257	metconazole	+	320	70.1	-23	-22	-15	125.1	-11	-40	-25
258	phorate	+	261	75	-29	-10	-30	47	-17	-55	-11
259	fipronil sulfone	-	451	415	17	17	19	282	17	27	18
260	famoxadone	+	392	331	-11	-12	-25	238	-13	-20	-10
261	tolclofos-methyl	+	301.1	125.2	-14	-16	-16	175.1	-20	-23	-20
262	clofentezine	+	303	138.1	-21	-14	-26	102.1	-21	-34	-19
263	prochloraz	+	376	308	-19	-11	-21	266	-19	-17	-29
264	phoxim	+	299	77.1	-30	-20	-30	129.1	-30	-25	-13
265	oxadiargyl	+	340.9	150.9	-13	-27	-27	223	-13	-15	-24
266	pyraclostrobin	+	388.1	194.1	-19	-20	-21	163.1	-19	-35	-30
267	bitertanol	+	338.2	269.2	-17	-9	-29	99.1	-17	-15	-18
268	pirimiphos-methyl	+	306.1	108.1	-30	-31	-19	95	-30	-29	-17
269	triflumuron	+	359.1	156	-17	-16	-30	139	-17	-33	-26
270	phosalone	+	368	182.1	-30	-14	-19	111	-30	-39	-20
271	diniconazole	+	326.1	70	-12	-24	-15	159	-12	-27	-18
272	benzoximate	+	364.1	199	-13	-12	-23	105	-27	-26	-21
273	pyraoxystrobin	+	413.1	205.1	-15	-18	-16	145	-15	-10	-17
274	disulfoton	+	275.2	89.1	-12	-15	-20	60.8	-10	-32	-12
275	chlorpyrifos-methyl	+	321.9	125.1	-22	-23	-23	125.1	-28	-15	-24
276	bifenox	+	359	310	-12	-15	-17	342	-10	-7	-27
277	metrafenone	+	409	209.1	-15	-17	-16	227.1	-20	-22	-18
278	pencycuron	+	329.1	125.1	-17	-15	-22	218.1	-17	-15	-23
279	cyflufenamid	+	413.2	295.1	-20	-10	-30	203	-20	-30	-20
280	ametoctradin	+	276.2	176.1	-10	-35	-20	149	-10	-35	-17
281	difenoconazole	+	406.1	251	-30	-25	-27	337.1	-30	-17	-24
282	EPN	+	324	156.9	-12	-20	-18	296.1	-11	-13	-16
283	cadusafos	+	271.1	159	-30	-20	-29	97	-30	-25	-18
284	isopyrazam	+	360.1	244	-11	-24	-25	320.1	-11	-21	-22
285	dimepiperate	+	264.1	146.1	-29	-7	-15	91.1	-29	-36	-16
286	spinosad A	+	732.4	142	-20	-27	-17	98.1	-20	-55	-21
287	diflufenican	+	395.1	266	-14	-35	-21	246	-14	-34	-19
288	ipconazole	+	334.2	70.1	-22	-26	-21	125.1	-13	-43	-13
289	triflumizole	+	346.1	73.1	-17	-25	-30	278	-17	-22	-30
290	indoxacarb	+	528.1	293	-26	-15	-21	249.1	-26	-17	-27
291	trifloxystrobin	+	409.1	186.1	-20	-40	-20	145	-20	-20	-26
292	prosulfocarb	+	252	91	-12	-45	-19	128	-12	-15	-15
293	cycloxydim	+	326.2	280.2	-12	-12	-21	180.2	-12	-20	-14
294	amisulbrom	+	466	227	-10	-19	-13	148	-10	-47	-29
295	pretilachlor	+	312.2	252.2	-15	-29	-28	176.2	-15	-35	-18
296	clethodim	+	360.2	164.1	-18	-19	-17	268.1	-18	-11	-30
297	hexaflumuron	-	459	438.9	16	12	29	175.1	16	36	29
298	fenaminstrobin	+	434.1	171	-21	-40	-20	212	-12	-14	-25

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
299	fluoroglycofen-ethyl	+	465.1	344	-17	-15	-26	223	-17	-33	-17
300	profenofos	+	372.9	302.8	-18	-25	-30	345	-18	-20	-24
301	quizalofop-ethyl	+	373	299	-13	-28	-20	270.9	-11	-26	-28
302	fenoxaprop-ethyl	+	362.1	288	-28	-26	-20	121.1	-28	-30	-23
303	oxyfluorfen	+	362	316	-18	-19	-25	140	-27	-52	-27
304	spinosad D	+	746.4	142	-28	-30	-17	98	-22	-55	-12
305	oxaziclomefone	+	376.1	190.1	-19	-34	-20	161.1	-19	-40	-28
306	diclofop-methyl	+	358	281	-25	-15	-22	120.2	-18	-27	-26
307	cyflumetofen	+	465.2	173	-14	-24	-18	145	-14	-55	-28
308	metamifop	+	441.1	288	-16	-24	-16	180	-21	-19	-21
309	terbufos	+	289	103.2	-14	-9	-18	57.1	-14	-24	-24
310	enestroburin	+	400.1	178	-19	-25	-14	137	-15	-15	-16
311	teflubenzuron	-	379	339	13	11	22	359	13	6	24
312	sethoxydim	+	328.1	178.1	-12	-19	-21	282.2	-12	-12	-22
313	fluazifop-butyl	+	384	328	-14	-11	-16	282	-14	-10	-30
314	furathiocarb	+	383.2	252.1	-27	-13	-27	195	-27	-10	-21
315	picolinafen	+	377.1	238.1	-19	-40	-24	359.1	-19	-25	-17
316	imibenconazole	+	411	125.1	-20	-31	-22	171	-20	-20	-18
317	propaquizafop	+	444.1	100.1	-23	-19	-19	371	-23	-16	-18
318	buprofezin	+	306.1	116.1	-30	-23	-12	201.1	-30	-20	-22
319	lactofen	+	479.2	344	-18	-25	-25	223.1	-18	-25	-25
320	tolfenpyrad	+	384.1	197.1	-10	-35	-12	154.1	-10	-35	-29
321	metaflumizone	-	505.1	302	24	21	30	285	24	48	28
322	oxadiazon	+	345	303	-16	-13	-13	220	-24	-18	-23
323	fluazinam	-	463	416	22	20	13	398	13	17	17
324	butachlor	+	312.2	238.1	-23	-11	-28	162	-16	-22	-13
325	pyriproxyfen	+	322.1	96.1	-30	-10	-10	185.1	-30	-20	-20
326	piperonyl butoxide	+	356.3	177.1	-24	-31	-19	119	-24	-22	-22
327	coumoxystrobin	+	437.1	205.1	-12	-10	-16	145.1	-12	-35	-17
328	ethion	+	385	199	-19	-15	-22	143	-19	-20	-25
329	pyribenzoxim	+	610.1	413.1	-22	-25	-30	180.1	-22	-20	-19
330	emamectin benzoate	+	886.5	158.1	-40	-25	-17	82.1	-40	-55	-15
331	spinetoram L	+	760.7	142.2	-22	-32	-25	98.2	-28	-55	-18
332	chlorpyrifos	+	351.9	199.9	-27	-18	-21	97	-27	-25	-18
333	spinetoram J	+	748.5	142.1	-40	-33	-14	98.2	-30	-55	-21
334	lufenuron	-	509	326	36	17	21	339	36	11	22
335	pendimethalin	+	282.2	212.1	-30	-10	-23	194	-30	-18	-20
336	hexythiazox	+	353.1	228	-18	-20	-24	168.1	-18	-30	-30
337	triallate	+	304	143	-15	-27	-25	86	-15	-17	-16
338	tralkoxydim	+	330.2	284.2	-16	-10	-30	138.1	-16	-25	-25
339	flucythrinate	+	469	412	-23	-14	-22	181	-30	-36	-10
340	flufenoxuron	+	489	158.1	-11	-20	-12	141.2	-11	-39	-17
341	propargite	+	368.2	231.2	-26	-17	-25	175.2	-26	-10	-19
342	dinocap	-	295.1	209	11	32	22	134.1	21	51	25
343	etoxazole	+	360.1	141.1	-30	-13	-26	113.1	-30	-35	-21
344	butralin	+	296.2	240.1	-14	-12	-25	222.1	-14	-21	-24
345	fenpropathrin	+	350.3	97.2	-12	-45	-19	125.2	-10	-23	-28

Table 2. List of MRM used for each pesticides.

No.	Compounds	Mode	Precursor ion	Quantifying ion	Q1 Pre Bias	CE	Q3 Pre Bias	Qualifying ion	Q1 Pre Bias	CE	Q3 Pre Bias
346	fenpyroximate	+	422.2	366.1	-30	-30	-26	138.1	-30	-25	-26
347	proquinazid	+	373	331	-18	-23	-18	289	-14	-40	-22
348	flumetralin	+	422.1	107.1	-22	-54	-22	143	-15	-47	-27
349	chlorfluazuron	+	540	382.9	-26	-21	-27	158	-26	-20	-30
350	spirodiclofen	+	411.1	71.2	-21	-16	-28	313.1	-21	-11	-22
351	deltamethrin	+	523	281	-36	-16	-22	506	-38	-11	-28
352	fenazaquin	+	307	161.1	-15	-10	-30	131	-15	-46	-24
353	fenvalerate	+	437	167.1	-17	-15	-26	125	-16	-40	-24
354	pyridaben	+	365.1	147.1	-18	-42	-27	309	-18	-23	-22
355	bioresmethrin	+	339.2	171.1	-24	-25	-18	128.1	-24	-25	-23
356	tau-fluvalinate	+	503.1	208	-40	-13	-22	181	-40	-30	-18
357	methoprene	+	279.2	191.2	-10	-9	-15	237.2	-10	-9	-28
358	abamectin	+	890.5	305.2	-34	-25	-22	567.3	-34	-14	-30
359	permethrin	+	408.2	183.1	-14	-14	-20	355.2	-21	-8	-27
360	etofenprox	+	394	177.1	-19	-26	-20	107	-19	-33	-19
361	bifenthrin	+	440.3	181.1	-16	-21	-18	166.2	-16	-43	-18
362	pyridalyl	+	491.9	110.9	-18	-27	-19	108.9	-18	-28	-20
363	ivermectin	+	892.5	569.2	-26	-16	-40	307.1	-26	-28	-20
364	benazolin-ethyl	+	272	198	-13	-15	-25	170	-18	-25	-19
365	pirimicarb-desmethyl-formamido	+	253.1	72	-20	-25	-20	225	-17	-10	-18
366	prochloraz metabolite BTS44595	+	325	282.1	-11	-15	-21	284.1	-11	-15	-21
367	prochloraz metabolite BTS44596	+	353	308	-12	-14	-17	310	-12	-14	-17
368	pyrethrin I	+	329.2	161.1	-11	-10	-19	133	-11	-19	-25
369	pyrethrin II	+	373.2	161.1	-11	-11	-19	133.1	-13	-20	-28
370	triflumizole metabolite FM-6-1	+	295	43.1	-10	-23	-18	73	-10	-18	-15
371	isocarbophos	+	231	121	-16	-19	-23	109	-11	-24	-13
372	cyazofamid metabolite CCIM	-	216	179.1	10	31	16	180.2	15	25	17
373	isoxaflutole-diketonitrile	-	358.1	79	12	23	26	64	12	50	11
374	spiromesifen	+	388	273.1	-14	-15	-21	255.2	-14	-27	-19
375	novaluron	+	493	158	-15	-18	-28	141.1	-15	-40	-27

[a] Pesticide contains two chromatograpeseedhic peaks, which are either its cis-trans isomers or non-enantiomeric isomers. The sum of the peak areas need to be used for quantification.

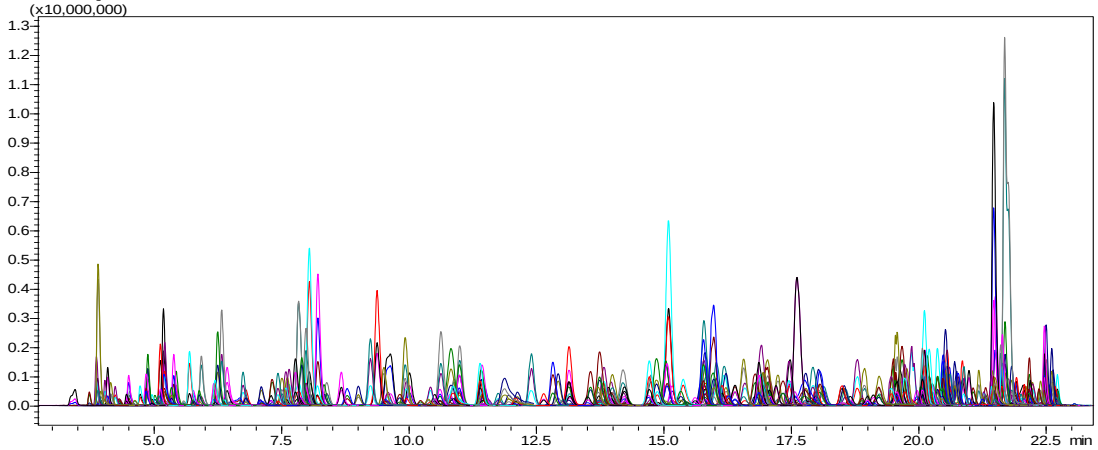

Figure 2. MRM chromatogram of 331 pesticides and their metabolites standards in mango matrix (concentration: 10 ng/mL).

Table 3. List of recovery and %RSD for each pesticides.

No.	Compounds	Spiked amount (0.01 mg/kg, n=3)	
		Avg recovery/%	%RSD
1	methamidophos	81.75	5.32
2	acephate	75.39	2.04
3	omethoate	80.83	0.20
4	oxamyl oxime	88.34	2.42
5	dinotefuran	74.81	4.67
6	propamocarb	74.75	6.74
7	aldicarb sulfoxide	79.35	8.81
8	aldicarb sulfone	79.79	7.77
9	oxamyl	73.20	13.19
10	nitenpyram	62.74	4.38
11	oxydemeton-methyl	85.34	1.83
12	demeton-S-methyl-sulfone	85.20	6.32
13	methomyl	67.17	18.31
14	monocrotophos	76.36	7.63
15	thiamethoxam	79.05	6.34
16	flonicamid	83.54	9.23
17	chlordimeform	79.42	5.30
18	phosfolan-methyl	82.46	10.53
19	spirotetramat-enol-glucoside	69.63	12.97
20	dicrotophos	80.09	13.22
21	imidacloprid	88.76	3.73
22	flumetsulam	91.68	2.18
23	clothianidin	94.70	2.37
24	methiocarb sulfoxide	85.15	4.59
25	imidaclothiz	94.29	2.46
26	vamidothion	91.45	5.76
27	3-hydroxy carbofuran	88.91	2.10
28	acetamiprid	87.45	3.97
29	mevinphos*	94.43	5.12
30	methiocarb sulfone	98.74	5.03
31	carbendazim	85.13	2.13
32	dimethoate	91.44	4.02
33	trichlorfon	99.00	5.31
34	demeton-S-sulfoxide	89.06	2.54
35	metamitron	98.87	9.23
36	diethyl aminoethyl hexanoate	82.35	3.02
37	sulfoxaflor*	92.64	3.51
38	chloridazon	89.50	3.85
39	demeton-S-sulfone	94.01	3.16
40	thiacloprid	92.57	3.31
41	cymoxanil	96.46	2.72
42	florasulam	84.09	2.09
43	fensulfothion oxon	85.99	1.38
44	pirimicarb-desmethyl	87.09	2.54
45	thiabendazole	68.68	3.98
46	tricyclazole	58.00	7.12
47	fensulfothion oxon sulfone	98.32	1.78
48	phosfolan	90.67	1.50
49	aldicarb	98.55	0.84
50	phosmet oxon	93.09	1.36
51	oxadixyl	91.43	2.21
52	formothion	96.27	3.33
53	cinosulfuron	87.28	2.18
54	metolcarb	96.93	3.89
55	thifensulfuron-methyl	82.72	2.96
56	probenazole	99.80	3.03
57	phosphamidon*	93.43	3.97
58	cyanazine	99.61	3.72
59	triasulfuron	91.82	2.36
60	phenamacril	95.96	1.23
61	metsulfuron-methyl	90.88	4.23
62	dichlorvos	96.15	1.02
63	thiophanate-methyl	99.57	2.02
64	thidiazuron	89.66	2.26
65	bendiocarb	98.55	2.34
66	spirotetramat-mono-hydroxy	96.72	0.58
67	propoxur	99.45	1.53
68	chlorsulfuron	76.10	2.86
69	carbofuran	96.78	1.50
70	fenamiphos sulfoxide	93.89	1.58
71	metribuzin	92.16	2.55
72	simazine	96.30	0.29
73	hexazinone	89.84	1.90
74	malaoxon	94.03	1.85
75	Amidosulfuron	85.97	1.59
76	demeton-S-methyl	95.46	2.79
77	fenthion sulfoxide	94.92	3.03

No.	Comppounds	Spiked amount (0.01 mg/kg, n=3)	
		Avg recovery	%RSD
78	fenamiphos sulfone	95.27	0.33
79	tebuthiuron	92.32	1.58
80	Sulfentrazone	88.83	7.13
81	carbaryl	93.73	5.66
82	carboxin	98.85	1.60
83	ethirimol	71.29	4.78
84	fenthion sulfone	102.77	1.18
85	penoxsulam	90.84	4.10
86	cyantraniliprole	97.20	2.13
87	pirimicarb	90.79	2.26
88	fosthiazate	98.21	2.00
89	spirotetramat-enol	77.43	1.86
90	disulfoton sulfoxide	93.19	2.85
91	chlortoluron	97.82	3.46
92	phorate sulfoxide	95.34	1.53
93	simetryn	95.50	0.38
94	mesosulfuron-methyl	85.54	5.55
95	methacrifos*	93.32	3.50
96	disulfoton sulfone	97.04	3.06
97	tritosulfuron	105.99	3.04
98	phorate sulfone	97.86	0.62
99	isoprocarb	98.34	1.63
100	flutriafol	93.33	4.44
101	tribenuron-methyl	85.29	2.78
102	atrazine	95.83	2.04
103	imazalil	90.24	2.56
104	isoproturon	99.04	0.58
105	metazachlor	94.67	2.59
106	fensulfothion	96.40	2.07
107	propachlor	96.50	3.58
108	chlorpropham	99.08	1.17
109	orthosulfamuron	84.73	5.67
110	iodosulfuron-methyl-sodium	83.09	1.62
111	diuron	95.23	0.82
112	forchlorfenuron	86.62	2.45
113	isoxaflutole	98.93	2.43
114	metalaxyl	93.61	0.96
115	heptenophos	99.96	0.73
116	fensulfothion sulfone	100.65	1.95
117	clethodim sulfone	90.91	3.45
118	metazosulfuron	70.73	5.12
119	spirotetramat-keto-hydroxy	101.98	1.83
120	methidathion	100.59	0.86
121	flumorph	95.23	3.14
122	fenpropidin	95.94	1.18
123	clethodim sulfoxide*	82.58	1.71
124	azinphos-methyl	99.78	3.30
125	phenmedipham	100.17	2.19
126	clomazone	94.48	4.71
127	phosmet	95.59	5.22
128	chlorantraniliprole	89.31	2.80
129	bensulfuron-methyl	89.13	1.75
130	demeton	95.06	1.36
131	pyriftalid	100.20	1.09
132	ametryn	94.14	1.91
133	flucetosulfuron*	83.41	1.78
134	fenobucarb	100.18	2.65
135	linuron	96.86	2.34
136	saflufenacil	88.39	1.96
137	pyrimethanil	100.91	1.71
138	propanil	99.02	1.43
139	albendazole	88.31	1.26
140	terbufos sulfone	99.55	3.50
141	terbufos sulfoxide	99.42	2.90
142	ethofumesate	100.85	0.10
143	methiocarb	98.43	0.98
144	diethofencarb	102.07	2.55
145	flurtamone	96.69	2.81
146	azoxystrobin	101.67	1.75
147	fludioxonil	97.30	2.35
148	fenamidone	94.95	2.05
149	halosulfuron-methyl	84.72	2.23
150	pyrisoxazole*	99.21	2.36
151	terbuthylazine	100.65	2.03
152	dimethenamid	97.05	2.46
153	promecarb	99.90	1.85
154	ethiprole	102.84	0.40
155	boscalid	97.59	4.48
156	chlorimuron-ethyl	66.44	1.26

Table 3 continue. List of recovery and %RSD for each pesticides

No.	Compounds	Spiked amount (0.01 mg/kg, n=3)		No.	Comppounds	Spiked amount (0.01 mg/kg, n=3)	
		Avg recovery/%	%RSD			Avg recovery/%	%RSD
157	propyzamide	100.07	1.80	237	carfentrazone-ethyl	104.42	4.43
158	paclobutrazol	97.95	3.63	238	tebuconazole	118.15	11.12
159	dimethomorph	87.23	4.08	239	fipronil sulfide	100.32	1.72
160	mandipropamid	97.31	4.91	240	fonofos	103.97	4.95
161	isoprothiolane	100.49	2.29	241	sulfotep	98.94	5.16
162	flutolanil	98.42	1.49	242	isofenphos-methyl	96.44	2.99
163	molinate	101.26	4.52	243	edifenphos	101.73	2.70
164	fluxapyroxad	101.52	6.61	244	propisochlor	106.86	4.76
165	ethoxysulfuron	74.98	1.47	245	benzovindiflupyr	103.82	2.36
166	triflusulfuron-methyl	93.04	0.98	246	zoxamide	97.97	0.72
167	fluopicolide	97.57	6.57	247	anilofos	94.13	1.80
168	malathion	102.46	1.12	248	propiconazole	98.57	4.06
169	mepronil	96.69	4.54	249	hexaconazole	95.44	3.34
170	myclobutanil	88.09	6.13	250	flubendiamide	95.32	3.41
171	triadimefon	87.92	4.76	251	diazinon	110.03	3.47
172	propyrisulfuron	87.29	1.84	252	pyraflufen-ethyl	102.11	3.60
173	fenpropimorph	102.39	6.12	253	coumaphos	99.73	1.99
174	pyrazosulfuron-ethyl	88.48	5.21	254	pyrimorph	99.41	2.59
175	bromuconazole	95.21	4.78	255	benalaxyl	99.46	2.47
176	mefenacet	102.63	3.80	256	chlorfenvinphos*	100.53	2.01
177	sedaxane*	102.05	2.99	257	metconazole	89.21	3.75
178	pyridaphenthion	97.06	1.32	258	phorate	93.11	3.57
179	methoxyfenozide	92.26	2.57	259	fipronil sulfone	99.27	3.09
180	prometryn	98.85	2.18	260	famoxadone	106.43	7.88
181	triadimenol	98.20	3.33	261	tolclofos-methyl	82.25	6.89
182	cyproconazole	94.26	3.00	262	clofentezine	106.72	6.07
183	triazophos	97.18	4.19	263	prochloraz	96.41	3.37
184	fenpyrazamine	103.16	3.58	264	phoxim	100.87	5.29
185	isazofos	97.62	1.68	265	oxadiargyl	88.11	7.80
186	procymidone	100.71	16.07	266	pyraclostrobin	178.52	22.86
187	cyclosulfamuron	86.79	4.12	267	bitertanol	93.90	3.56
188	fenarimol	100.27	1.50	268	pirimiphos-methyl	95.91	3.00
189	fluopyram	101.88	2.57	269	triflumuron	105.40	2.26
190	fenhexamid	91.70	0.44	270	phosalone	101.38	5.60
191	iprovalicarb*	97.94	5.87	271	diniconazole	96.09	2.08
192	triticonazole	92.43	1.46	272	benzoximate	103.43	5.58
193	tetraconazole	94.94	7.19	273	pyraoxystrobin	112.20	3.44
194	ethoprophos	100.66	9.22	274	disulfoton	90.72	6.15
195	spirotetramat	97.67	3.06	275	chlorpyrifos-methyl	85.93	10.14
196	flufenacet	93.19	3.23	276	bifenox	100.61	27.50
197	napropamide	98.51	4.04	277	metrafenone	96.58	3.89
198	acetochlor	95.17	5.30	278	pencycuron	99.67	2.44
199	chromafenozide	96.28	6.89	279	cyflufenamid	84.52	6.80
200	alachlor	95.53	4.05	280	ametoctradin	88.64	3.12
201	epoxiconazole	95.59	5.88	281	difenoconazole*	135.41	12.01
202	cyazofamid	104.39	1.82	282	EPN	184.36	23.42
203	metolachlor	99.33	6.33	283	cadusafos	91.91	5.02
204	uniconazole	94.19	4.25	284	isopyrazam*	101.07	5.58
205	fenbuconazole	101.86	2.17	285	dimepiperate	97.21	3.88
206	diflubenzuron	109.23	4.40	286	spinosad A	87.44	3.74
207	iprodione	124.14	23.25	287	diflufenican	103.92	7.39
208	fipronil desulfinyl	99.85	1.26	288	ipconazole*	100.18	0.98
209	thifluzamide	109.39	2.45	289	triflumizole	104.92	2.36
210	fenothiocarb	106.29	12.10	290	indoxacarb	92.42	8.67
211	picoxystrobin	100.34	7.71	291	trifloxystrobin	130.81	11.84
212	rotenone	92.49	1.83	292	prosulfocarb	98.05	4.46
213	bupirimate	90.81	3.27	293	cycloxydim	97.51	6.06
214	flusilazole	97.48	5.47	294	amisulbrom	101.15	15.37
215	fenoxycarb	97.71	1.06	295	pretilachlor	103.18	2.30
216	fenamiphos	107.68	3.32	296	clethodim	87.76	2.62
217	parathion	88.12	53.14	297	hexaflumuron	87.31	4.23
218	cyprodinil	100.67	1.01	298	fenaminstrobin	98.62	4.90
219	fenoxanil*	106.91	1.44	299	fluoroglycofen-ethyl	89.82	5.32
220	quinalphos	97.99	2.33	300	profenofos	100.43	8.74
221	dimoxystrobin	94.80	2.70	301	quizalofop-ethyl	105.56	9.26
222	fipronil	101.53	13.07	302	fenoxaprop-ethyl	115.40	3.06
223	tebufenozide	92.65	6.24	303	oxyfluorfen	103.27	11.16
224	silthiofam	77.86	2.89	304	spinosad D	87.47	2.70
225	penconazole	108.91	1.28	305	oxaziclomefone	108.40	0.89
226	penthiopyrad	113.54	1.33	306	diclofop-methyl	113.96	12.84
227	chlorbenzuron	93.79	3.61	307	cyflumetofen	145.56	5.61
228	phenthoate	96.44	1.84	308	metamifop	102.27	4.04
229	kresoxim-methyl	103.34	4.16	309	terbufos	108.44	3.90
230	fluthiacet-methyl	91.89	1.63	310	enestroburin	95.82	8.79
231	diclobutrazol	98.25	2.97	311	teflubenzuron	95.19	4.43
232	pyrametostrobin	105.46	1.74	312	sethoxydim	96.92	4.60
233	penflufen	98.23	3.32	313	fluazifop-butyl	100.53	2.41
234	iprobenfos	101.20	1.17	314	furathiocarb	100.81	7.59
235	fenthion	102.43	3.00	315	picolinafen	101.53	11.45
236	etrimfos	101.87	3.10	316	imibenconazole	92.51	10.76

Table 3 continue. List of recovery and %RSD for each pesticides.

No.	Comppounds	Spiked amount (0.01 mg/kg, n=3)	
		Avg recovery/%	%RSD
317	propaquizafop	100.75	6.47
318	buprofezin	113.12	5.13
319	lactofen	92.93	11.76
320	tolfenpyrad	235.46	24.05
321	metaflumizone	80.36	9.51
322	oxadiazon	99.58	9.43
323	fluazinam	92.64	4.12
324	butachlor	104.39	0.25
325	pyriproxyfen	119.75	8.90
326	piperonyl butoxide	94.53	11.10
327	coumoxystrobin	105.23	5.45
328	ethion	106.97	5.71
329	pyribenzoxim	93.78	7.40
330	emamectin benzoate	84.60	6.95
331	spinetoram L	68.33	11.02
332	chlorpyrifos	86.79	18.64
333	spinetoram J	84.02	1.80
334	lufenuron	80.24	6.99
335	pendimethalin	99.12	4.09
336	hexythiazox	99.90	9.11
337	triallate	87.04	12.24
338	tralkoxydim	90.13	4.10
339	flucythrinate	85.34	15.56
340	flufenoxuron	93.82	13.56
341	propargite	108.45	2.25
342	dinocap*	86.23	9.44
343	etoxazole	102.11	2.53
344	butralin	106.76	10.26
345	fenpropathrin	98.52	14.37
346	fenpyroximate	109.50	3.34
347	proquinazid	101.06	0.17
348	flumetralin	102.38	3.60
349	chlorfluazuron	86.67	14.20
350	spirodiclofen	102.25	3.50
351	deltamethrin	84.68	12.89
352	fenazaquin	94.91	3.29
353	fenvalerate	94.96	23.88
354	pyridaben	103.69	3.50
355	bioresmethrin	99.25	5.08
356	tau-fluvalinate	98.63	8.39
357	methoprene	108.26	1.45
358	abamectin	97.56	10.79
359	permethrin*	90.89	5.84
360	etofenprox	100.78	2.68
361	bifenthrin	107.71	9.99
362	pyridalyl	93.49	2.41
363	ivermectin	96.68	9.32
364	benazolin-ethyl	97.53	1.23
365	pirimicarb-desmethyl-formamido	95.99	3.10
366	prochloraz metabolite BTS44595	98.85	2.67
367	prochloraz metabolite BTS44596	99.58	0.55
368	pyrethrin I	100.28	7.76
369	pyrethrin II	99.38	3.52
370	triflumizole metabolite FM-6-1	95.21	1.78
371	isocarbophos	96.94	3.35
372	cyazofamid metabolite CCIM	94.01	2.61
373	isoxaflutole-diketonitrile	109.41	2.55
374	spiromesifen	116.45	32.22
375	novaluron	115.05	10.56

■ Results and Discussion

Mango blank matrix was spiked with a standard solution of pesticides to a final concentration of 0.01 mg/kg. QuEChERS method sample preparation was performed according to Figure 1. Figure 2 shows the MRM chromatogram of the pesticide standards in mango matrix. Three independent experiment was performed to determine average recovery and %RSD. Results show 367 compounds having a good recovery rate between 70.0%-120.0%. %RSD show 373 compounds were below 30%. Recovery and %RSD for all the compounds are shown in Table 3.

■ Conclusion

This study presents a method for the determination of residues of 331 pesticides and their metabolites in mango. Shimadzu SHIMSEN QuEChERS products were used for clean-up of the mango, followed by analysis using Shim-pack GIST C18-AQ column on Shimadzu LCMS-8060NX. The recovery and reproducibility was determined using 0.01 mg/kg spiked mango and mango blank sample. The method has high recovery and good reproducibility, providing a reference for the determination of residues of 331 pesticides and their metabolites in mango.

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