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LCMS-8060NX

Application News

SGLC-LC/MS-083EN

Analysis of 331 Pesticides and Their Metabolites in Bell pepper

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User Benefits

- Established an effective, fast and simple sample preparation method for analysis of pesticides in bell pepper.
- 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. Bell pepper, a common coloured vegetable, are no exception. Pesticide residues in bell pepper 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 bell pepper 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.

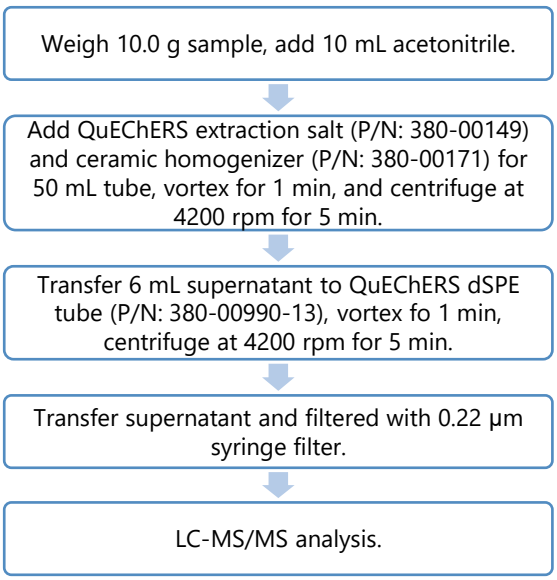

Figure 1. QuEChERS sample preparation workflow for bell pepper.

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.

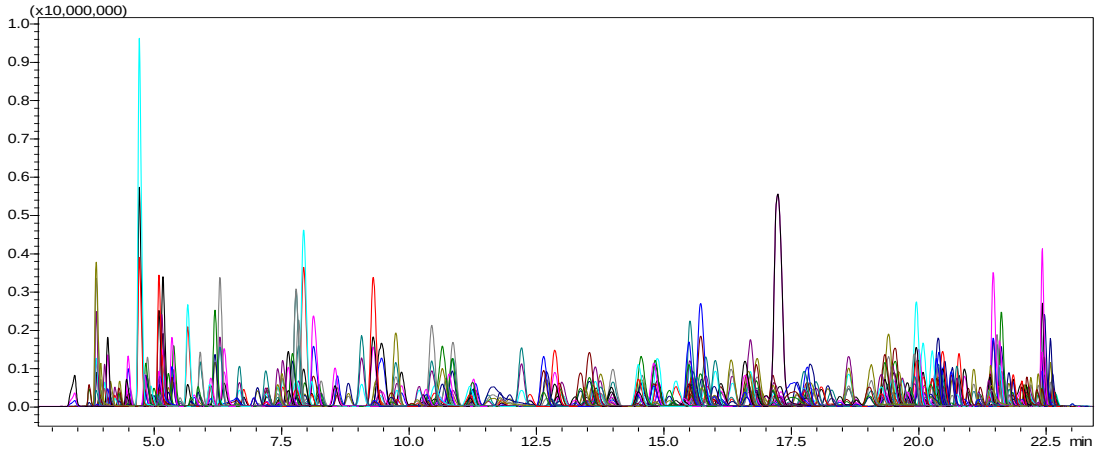

Figure 2. MRM chromatogram of 331 pesticides and their metabolites standards in bell pepper matrix (concentration: 10 ng/mL).

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	90.37	5.88
2	acephate	95.78	4.51
3	omethoate	100.67	3.26
4	oxamyl oxime	100.19	4.18
5	dinotefuran	101.71	2.55
6	propamocarb	89.19	3.47
7	aldicarb sulfoxide	104.97	3.52
8	aldicarb sulfone	105.63	9.57
9	oxamyl	107.63	5.16
10	nitenpyram	96.99	4.32
11	oxydemeton-methyl	95.37	1.88
12	demeton-S-methyl-sulfone	102.68	2.16
13	methomyl	106.47	3.57
14	monocrotophos	107.51	4.50
15	thiamethoxam	106.78	4.12
16	flonicamid	94.49	10.98
17	chlordimeform	102.47	7.51
18	phosfolan-methyl	101.87	4.65
19	spirotetramat-enol-glucoside	95.43	3.53
20	dicrotophos	100.62	3.85
21	imidacloprid	103.42	4.68
22	flumetsulam	83.67	3.72
23	clothianidin	109.47	2.84
24	methiocarb sulfoxide	103.29	6.43
25	imidaclothiz	106.77	4.43
26	vamidothion	102.68	5.56
27	3-hydroxy carbofuran	107.50	4.20
28	acetamiprid	109.42	3.28
29	mevinphos*	104.35	2.33
30	methiocarb sulfone	107.23	4.49
31	carbendazim	98.28	2.82
32	dimethoate	108.31	3.51
33	trichlorfon	109.00	1.16
34	demeton-S-sulfoxide	104.16	5.44
35	metamitron	106.02	4.51
36	diethyl aminoethyl hexanoate	105.88	3.02
37	sulfoxaflor*	101.59	3.38
38	chloridazon	104.42	2.64
39	demeton-S-sulfone	105.77	3.26
40	thiacloprid	106.64	2.00
41	cymoxanil	103.29	0.80
42	florasulam	99.98	5.72
43	fensulfothion oxon	101.58	2.04
44	pirimicarb-desmethyl	105.58	4.14
45	thiabendazole	72.22	2.81
46	tricyclazole	105.27	3.98
47	fensulfothion oxon sulfone	105.18	5.90
48	phosfolan	104.92	3.61
49	aldicarb	109.38	2.93
50	phosmet oxon	106.00	4.02
51	oxadixyl	118.04	3.57
52	formothion	108.65	5.86
53	cinosulfuron	93.64	5.06
54	metolcarb	102.05	2.89
55	thifensulfuron-methyl	92.46	4.72
56	probenazole	104.99	3.45
57	phosphamidon*	95.74	5.20
58	cyanazine	108.45	6.13
59	triasulfuron	98.53	5.88
60	phenamacril	111.53	3.60
61	metsulfuron-methyl	94.05	4.62
62	dichlorvos	101.64	3.61
63	thiophanate-methyl	105.62	0.68
64	thidiazuron	103.05	3.91
65	bendiocarb	101.60	2.65
66	spirotetramat-mono-hydroxy	105.16	4.49
67	propoxur	107.11	1.57
68	chlorsulfuron	86.25	2.07
69	carbofuran	106.15	2.09
70	fenamiphos sulfoxide	103.53	3.01
71	metribuzin	114.36	2.66
72	simazine	102.80	3.19
73	hexazinone	106.84	1.43
74	malaoxon	107.31	5.33
75	Amidosulfuron	92.31	5.72
76	demeton-S-methyl	106.05	4.67
77	fenthion sulfoxide	110.26	1.98

No.	Comppounds	Spiked amount (0.01 mg/kg, n=3)	
		Avg recovery	%RSD
78	fenamiphos sulfone	103.35	2.50
79	tebuthiuron	106.74	1.22
80	Sulfentrazone	105.11	6.12
81	carbaryl	108.83	1.31
82	carboxin	101.80	2.47
83	ethirimol	99.60	3.86
84	fenthion sulfone	105.45	2.32
85	penoxsulam	94.43	3.28
86	cyantraniliprole	109.86	5.20
87	pirimicarb	105.45	3.61
88	fosthiazate	105.51	2.29
89	spirotetramat-enol	91.31	9.51
90	disulfoton sulfoxide	110.01	3.83
91	chlortoluron	106.38	2.47
92	phorate sulfoxide	105.87	2.16
93	simetryn	104.65	3.33
94	mesosulfuron-methyl	94.69	3.49
95	methacrifos*	104.87	6.71
96	disulfoton sulfone	106.47	3.09
97	tritosulfuron	104.12	2.48
98	phorate sulfone	108.20	1.94
99	isoprocarb	109.43	3.50
100	flutriafol	103.04	1.88
101	tribenuron-methyl	103.62	2.88
102	atrazine	109.24	3.24
103	imazalil	97.36	2.76
104	isoproturon	106.91	1.73
105	metazachlor	107.46	4.34
106	fensulfothion	112.58	1.43
107	propachlor	103.68	2.20
108	chlorpropham	110.15	0.73
109	orthosulfamuron	90.93	4.81
110	iodosulfuron-methyl-sodium	99.82	1.70
111	diuron	116.90	0.42
112	forchlorfenuron	102.16	3.54
113	isoxaflutole	112.94	6.91
114	metalaxyl	106.36	1.43
115	heptenophos	113.37	1.62
116	fensulfothion sulfone	118.31	1.95
117	clethodim sulfone	97.35	4.00
118	metazosulfuron	101.24	4.17
119	spirotetramat-keto-hydroxy	106.88	3.28
120	methidathion	105.78	3.59
121	flumorph	100.10	1.57
122	fenpropidin	101.66	5.13
123	clethodim sulfoxide*	88.89	1.86
124	azinphos-methyl	108.82	5.97
125	phenmedipham	108.48	5.22
126	clomazone	108.00	3.03
127	phosmet	97.38	2.71
128	chlorantraniliprole	108.43	3.45
129	bensulfuron-methyl	97.41	3.28
130	demeton	102.89	1.96
131	pyriftalid	103.39	4.75
132	ametryn	102.90	6.47
133	flucetosulfuron*	93.88	3.98
134	fenobucarb	98.55	18.84
135	linuron	105.98	3.07
136	saflufenacil	97.43	2.89
137	pyrimethanil	102.89	5.00
138	propanil	106.06	4.39
139	albendazole	100.45	3.02
140	terbufos sulfone	107.51	6.57
141	terbufos sulfoxide	106.93	5.63
142	ethofumesate	103.31	2.09
143	methiocarb	103.62	4.01
144	diethofencarb	103.58	3.34
145	flurtamone	104.74	3.91
146	azoxystrobin	109.96	6.10
147	fludioxonil	103.59	5.52
148	fenamidone	105.13	3.27
149	halosulfuron-methyl	99.28	3.65
150	pyrisoxazole*	105.91	4.10
151	terbuthylazine	107.33	2.96
152	dimethenamid	107.01	3.26
153	promecarb	107.02	5.97
154	ethiprole	107.91	2.76
155	boscalid	104.91	3.30
156	chlorimuron-ethyl	94.03	3.06

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	102.77	1.83	237	carfentrazone-ethyl	101.26	5.18
158	paclobutrazol	102.98	4.99	238	tebuconazole	98.56	3.21
159	dimethomorph	103.77	3.17	239	fipronil sulfide	105.48	2.68
160	mandipropamid	104.69	3.79	240	fonofos	101.61	3.58
161	isoprothiolane	102.87	1.28	241	sulfotep	102.43	3.83
162	flutolanil	103.87	0.60	242	isofenphos-methyl	101.95	1.17
163	molinate	101.73	0.87	243	edifenphos	103.00	5.76
164	fluxapyroxad	97.19	4.66	244	propisochlor	109.01	0.09
165	ethoxysulfuron	97.74	5.89	245	benzovindiflupyr	101.47	4.09
166	triflusulfuron-methyl	99.90	2.49	246	zoxamide	104.03	0.92
167	fluopicolide	106.26	2.86	247	anilofos	104.50	5.61
168	malathion	106.17	3.07	248	propiconazole	101.49	3.46
169	mepronil	107.20	0.92	249	hexaconazole	102.79	3.96
170	myclobutanil	103.47	3.26	250	flubendiamide	102.89	2.93
171	triadimefon	105.08	2.04	251	diazinon	106.96	3.98
172	propyrisulfuron	91.49	2.44	252	pyraflufen-ethyl	102.55	4.20
173	fenpropimorph	100.87	4.09	253	coumaphos	102.58	2.72
174	pyrazosulfuron-ethyl	98.39	2.24	254	pyrimorph	104.40	3.51
175	bromuconazole	107.03	3.10	255	benalaxyl	103.84	3.01
176	mefenacet	102.99	3.49	256	chlorfenvinphos*	105.54	2.52
177	sedaxane*	101.28	1.25	257	metconazole	105.54	1.22
178	pyridaphenthion	99.63	1.86	258	phorate	105.61	1.74
179	methoxyfenozide	107.98	3.85	259	fipronil sulfone	102.01	1.84
180	prometryn	106.35	4.18	260	famoxadone	111.76	5.13
181	triadimenol	101.86	3.58	261	tolclofos-methyl	119.07	11.43
182	cyproconazole	106.88	0.44	262	clofentezine	98.61	4.54
183	triazophos	117.21	14.54	263	prochloraz	104.99	5.63
184	fenpyrazamine	102.28	5.22	264	phoxim	100.06	1.55
185	isazofos	111.78	10.47	265	oxadiargyl	101.62	3.27
186	procymidone	93.80	45.35	266	pyraclostrobin	98.21	3.26
187	cyclosulfamuron	94.09	4.82	267	bitertanol	109.72	3.00
188	fenarimol	104.07	1.87	268	pirimiphos-methyl	105.54	1.56
189	fluopyram	107.84	2.18	269	triflumuron	100.81	3.69
190	fenhexamid	101.19	6.12	270	phosalone	99.55	4.69
191	iprovalicarb*	113.15	11.05	271	diniconazole	103.15	1.78
192	triticonazole	114.84	11.06	272	benzoximate	110.69	3.96
193	tetraconazole	109.91	10.61	273	pyraoxystrobin	105.22	4.16
194	ethoprophos	110.73	16.46	274	disulfoton	102.69	3.43
195	spirotetramat	109.43	8.05	275	chlorpyrifos-methyl	111.39	2.17
196	flufenacet	112.27	15.89	276	bifenox	79.18	22.60
197	napropamide	104.30	5.60	277	metrafenone	101.26	2.36
198	acetochlor	103.90	6.49	278	pencycuron	105.71	4.15
199	chromafenozide	101.56	5.14	279	cyflufenamid	106.07	2.71
200	alachlor	112.12	6.60	280	ametoctradin	104.15	1.97
201	epoxiconazole	105.08	5.17	281	difenoconazole*	98.68	1.84
202	cyazofamid	102.65	2.32	282	EPN	174.13	28.95
203	metolachlor	110.26	3.70	283	cadusafos	99.33	6.01
204	uniconazole	103.63	2.74	284	isopyrazam*	102.64	3.10
205	fenbuconazole	104.23	0.93	285	dimepiperate	106.04	2.65
206	diflubenzuron	103.56	6.16	286	spinosad A	103.53	3.28
207	iprodione	74.28	41.70	287	diflufenican	100.20	2.40
208	fipronil desulfinyl	104.29	1.25	288	ipconazole*	100.20	1.26
209	thifluzamide	112.81	5.96	289	triflumizole	97.38	2.40
210	fenothiocarb	103.02	3.21	290	indoxacarb	108.65	8.67
211	picoxystrobin	109.03	2.64	291	trifloxystrobin	102.16	3.11
212	rotenone	109.90	4.38	292	prosulfocarb	100.81	1.06
213	bupirimate	97.59	7.19	293	cycloxydim	102.15	1.18
214	flusilazole	107.12	2.68	294	amisulbrom	109.65	17.59
215	fenoxycarb	98.18	6.41	295	pretilachlor	91.65	4.22
216	fenamiphos	105.17	4.15	296	clethodim	93.66	2.94
217	parathion	126.37	5.45	297	hexaflumuron	100.09	6.21
218	cyprodinil	102.47	3.19	298	fenaminstrobin	104.76	1.78
219	fenoxanil*	105.35	5.45	299	fluoroglycofen-ethyl	103.42	6.57
220	quinalphos	107.32	4.47	300	profenofos	105.38	1.54
221	dimoxystrobin	98.48	2.19	301	quizalofop-ethyl	108.86	2.13
222	fipronil	102.97	4.27	302	fenoxaprop-ethyl	106.03	0.85
223	tebufenozide	102.91	2.06	303	oxyfluorfen	102.42	4.93
224	silthiofam	96.99	7.37	304	spinosad D	103.61	0.61
225	penconazole	101.60	4.48	305	oxaziclomefone	102.86	3.06
226	penthiopyrad	102.55	1.94	306	diclofop-methyl	114.95	13.35
227	chlorbenzuron	90.63	4.95	307	cyflumetofen	105.00	1.90
228	phenthoate	98.38	4.61	308	metamifop	111.01	5.49
229	kresoxim-methyl	104.67	3.79	309	terbufos	116.33	13.57
230	fluthiacet-methyl	111.61	2.91	310	enestroburin	109.98	5.98
231	diclobutrazol	101.29	4.35	311	teflubenzuron	89.79	3.44
232	pyrametostrobin	101.60	1.74	312	sethoxydim	104.33	2.07
233	penflufen	102.04	2.22	313	fluazifop-butyl	112.23	4.54
234	iprobenfos	103.86	0.98	314	furathiocarb	94.42	2.39
235	fenthion	106.83	6.51	315	picolinafen	107.49	1.05
236	etrimfos	104.05	3.40	316	imibenconazole	105.11	3.10

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	108.76	4.89
318	buprofezin	117.65	5.01
319	lactofen	97.21	2.66
320	tolfenpyrad	102.66	5.06
321	metaflumizone	89.17	2.50
322	oxadiazon	106.94	10.56
323	fluazinam	103.44	3.23
324	butachlor	110.12	4.69
325	pyriproxyfen	117.27	3.73
326	piperonyl butoxide	103.58	3.27
327	coumoxystrobin	114.10	4.10
328	ethion	115.94	1.78
329	pyribenzoxim	113.17	2.04
330	emamectin benzoate	105.30	3.49
331	spinetoram L	144.48	27.49
332	chlorpyrifos	113.19	7.03
333	spinetoram J	105.03	2.45
334	lufenuron	88.98	9.99
335	pendimethalin	111.08	4.16
336	hexythiazox	114.15	3.21
337	triallate	103.87	7.35
338	tralkoxydim	108.29	5.05
339	flucythrinate	141.84	10.69
340	flufenoxuron	107.68	5.74
341	propargite	118.38	4.59
342	dinocap*	95.49	3.75
343	etoxazole	113.29	4.67
344	butralin	104.98	8.43
345	fenpropathrin	116.44	7.78
346	fenpyroximate	119.11	6.44
347	proquinazid	119.95	1.91
348	flumetralin	117.27	4.36
349	chlorfluazuron	111.95	3.92
350	spirodiclofen	117.25	6.95
351	deltamethrin	117.08	2.06
352	fenazaquin	114.37	2.23
353	fenvalerate	151.02	36.14
354	pyridaben	114.85	2.80
355	bioresmethrin	94.46	8.42
356	tau-fluvalinate	112.25	0.75
357	methoprene	94.90	5.01
358	abamectin	65.37	20.07
359	permethrin*	177.37	8.89
360	etofenprox	119.72	5.03
361	bifenthrin	119.28	3.33
362	pyridalyl	95.21	67.65
363	ivermectin	114.06	8.63
364	benazolin-ethyl	105.20	2.57
365	pirimicarb-desmethyl-formamido	107.78	1.83
366	prochloraz metabolite BTS44595	100.68	3.48
367	prochloraz metabolite BTS44596	104.10	6.15
368	pyrethrin I	119.53	6.75
369	pyrethrin II	95.01	7.33
370	triflumizole metabolite FM-6-1	101.73	3.44
371	isocarbophos	98.35	0.78
372	cyazofamid metabolite CCIM	104.44	5.46
373	isoxaflutole-diketonitrile	92.39	7.56
374	spiromesifen	128.24	5.66
375	novaluron	99.36	8.09

■ Results and Discussion

Bell pepper 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 bell pepper matrix. Three independent experiment was performed to determine average recovery and %RSD. Results show 368 compounds having a good recovery rate between 60.0%-120.0%. %RSD show 371 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 bell pepper. Shimadzu SHIMSEN QuEChERS products were used for clean-up of the bell pepper, 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 bell pepper and bell pepper 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 bell pepper.

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