

Analysis of Organophosphorus Pesticides with Agilent 7820 Gas Chromatograph/ Flame Photometric Detector

ENVIRONMENTAL



The Agilent 7820 series gas chromatograph (GC) equipped with a flame photometric detector (FPD) provides high sensitivity, good linearity, and stability for the analysis of organophosphorus pesticides.

Synthetic organic pesticides are widely used in modern agriculture to protect crops and improve production. However, these compounds are very toxic when absorbed by human organisms because of acetylcholinesterase deactivation. Maximum residue levels (MRLs) have been regulated for 27 OPs in different kinds of agricultural products, and analytical methods have been developed to avoid any adverse impact on public health.

The Agilent 7820 series gas chromatograph (GC) equipped with a flame photometric detector (FPD) provides high sensitivity, good linearity, and stability for the analysis of organophosphorus pesticides. The results achieved are better than the requirements of the Chinese agriculture industry standard NY_T 761.1-2004 [1].

Experimental

Table 1. Analytical Conditions

Inlet	Split/Splitless inlet
Inlet temperature	220 °C
Injection mode	Splitless
Injection volume	1 µL
Purge time	0.75 minutes
Column	DB-1701P, 0.32 mm × 30 m, 0.25 µm (p/n 123-7732)
Carrier gas	He, 4 mL/min constant flow
Oven program	100 °C, no hold; 25 °C/min to 150 °C, no hold; 5 °C/min to 250 °C, hold 5 minutes
Detector	FPD at 250 °C in Phosphorus mode
Detector gas	H ₂ 75 mL/min Air 100 mL/min Makeup N ₂ 60 mL/min
Data analysis system	Agilent Chemstation

Key Benefits

- The Agilent 7820 GC-FPD provides high sensitivity for the analysis of organophosphorus pesticides.
- ALS and EPC ensure good repeatability and ease of use.
- Agilent Chemstation software is available for the Agilent 7820 system control and data analysis.



Results and Discussion

The Agilent 7820 GC-FPD provides high sensitivity for trace pesticide analysis. Figure 1 shows the chromatogram of 10 µg/L pesticides using an Agilent 7820 GC-FPD with excellent signal to noise (S/N). Table 2 shows good linearity with $R^2 > 0.999$ for most compounds in the range of 10–1,000 µg/L, which suggests that the 7820-FPD is well suited for low-level OP quantification. The MDLs (S/N = 3) are much lower than the maximum residue levels (MRLs) for the OPs [2].

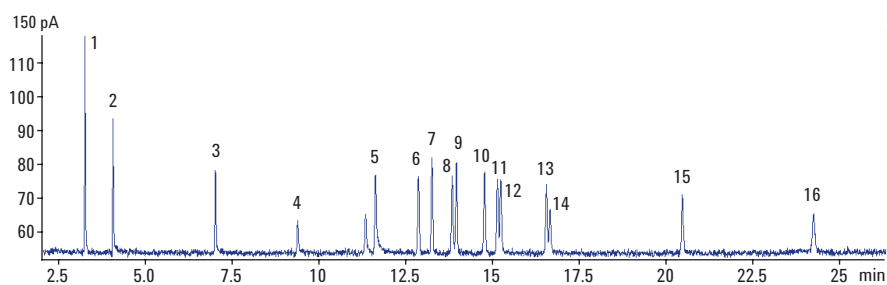


Figure 1. Chromatogram of 16 OPs at 10 µg/L using an Agilent 7820 GC-FPD.

Table 2. MDL (S/N = 3) and Linearity Ranged from 10 to 1,000 µg/L

	Compound Name	MDL (µg/L)	Linearity range(µg/L)	Linearity R ²
1	Dichlorvos	1.0	10–1,000	1
2	Methamidophos	1.5	10–1,000	0.9991
3	Acephate	2.4	10–1,000	0.9992
4	Omethoate	6.2	10–1,000	0.9977
5	Dimethoate	2.5	10–1,000	0.9997
6	Chlorpyrifos	2.4	10–1,000	0.9997
7	Methyl parathion	2.2	10–1,000	0.9997
8	Malathion	2.4	10–1,000	0.9997
9	Fenitrothion	2.1	10–1,000	0.9998
10	Isofenphos-methyl	2.3	10–1,000	0.9998
11	Quinalphos	2.8	10–1,000	0.9997
12	Isocarbophos	2.6	10–1,000	0.9997
13	Methidathion	2.6	10–1,000	0.9993
14	Profenofos	3.9	10–1,000	0.9992
15	Triazophos	3.3	10–1,000	0.9984
16	Phosalone	4.3	10–1,000	0.9978

The use of an automatic liquid sampler (ALS) and EPC ensure the ease of use of an Agilent 7820 GC-FPD and its good repeatability. As shown in Table 3, the relative standard deviation (RSD) of the retention time (RT) of the 16 OPs was lower than 0.013%. Peak areas were reproducible with an RSD of less than 4% at the concentration of 0.200 mg/L. Good RT and peak area repeatability ensure reliable qualitative and quantitative analysis.

Table 3. Reproducibility of Peak Area and Retention Time (n = 10)

Peak number	0.050 mg/L		0.200 mg/L	
	Area RSD%	RT RSD%	Area RSD%	RT RSD%
1	1.87%	0.009%	0.71%	0.008%
2	2.67%	0.011%	2.27%	0.007%
3	3.79%	0.023%	3.57%	0.008%
4	6.51%	0.016%	3.27%	0.008%
5	2.99%	0.009%	1.91%	0.011%
6	1.71%	0.009%	0.76%	0.008%
7	2.64%	0.007%	1.34%	0.009%
8	2.03%	0.007%	0.86%	0.010%
9	1.94%	0.012%	0.93%	0.008%
10	2.20%	0.012%	1.36%	0.008%
11	3.02%	0.007%	1.23%	0.013%
12	4.05%	0.012%	1.71%	0.007%
13	3.77%	0.006%	1.73%	0.009%
14	5.01%	0.013%	2.64%	0.012%
15	6.35%	0.007%	3.13%	0.010%
16	5.52%	0.012%	2.92%	0.011%

An apple was used as an example to demonstrate the applicability of the Agilent 7820 GC-FPD for the OPs residue analysis (Figure 2). Recovery of 16 OPs at spiked level of 0.2 mg/kg ranged from 83% to 106% (Table 4). The sample preparation method refers to standard NY_T 761.1-2004.

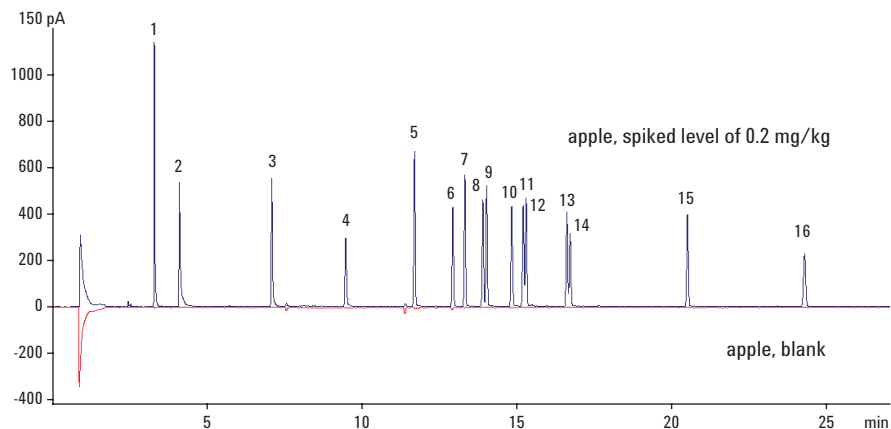


Figure 2. Chromatogram of 0.2 mg/kg spiked sample and blank sample.

Table 4. Recovery of 16 OPs at Spiked Level of 0.2 mg/kg

Peak number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Recovery (%)	91	83	100	106	102	96	96	96	95	95	94	97	92	97	94	100

Conclusions

The Agilent 7820 Series GC with an FPD can be used for sensitive and selective measurement of OPs. The FPD detector provides good linearity and repeatability for most of these phosphorus containing compounds in the low concentration range from 10–1,000 ppb.

References

1. NY_T 761.1-2004, Determination method for multi organophosphorus pesticides in vegetables and fruits.
2. Jiming Ye *et al*, Introduction of maximum residues limits in China, (2000) Pesticide Science and Management.

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