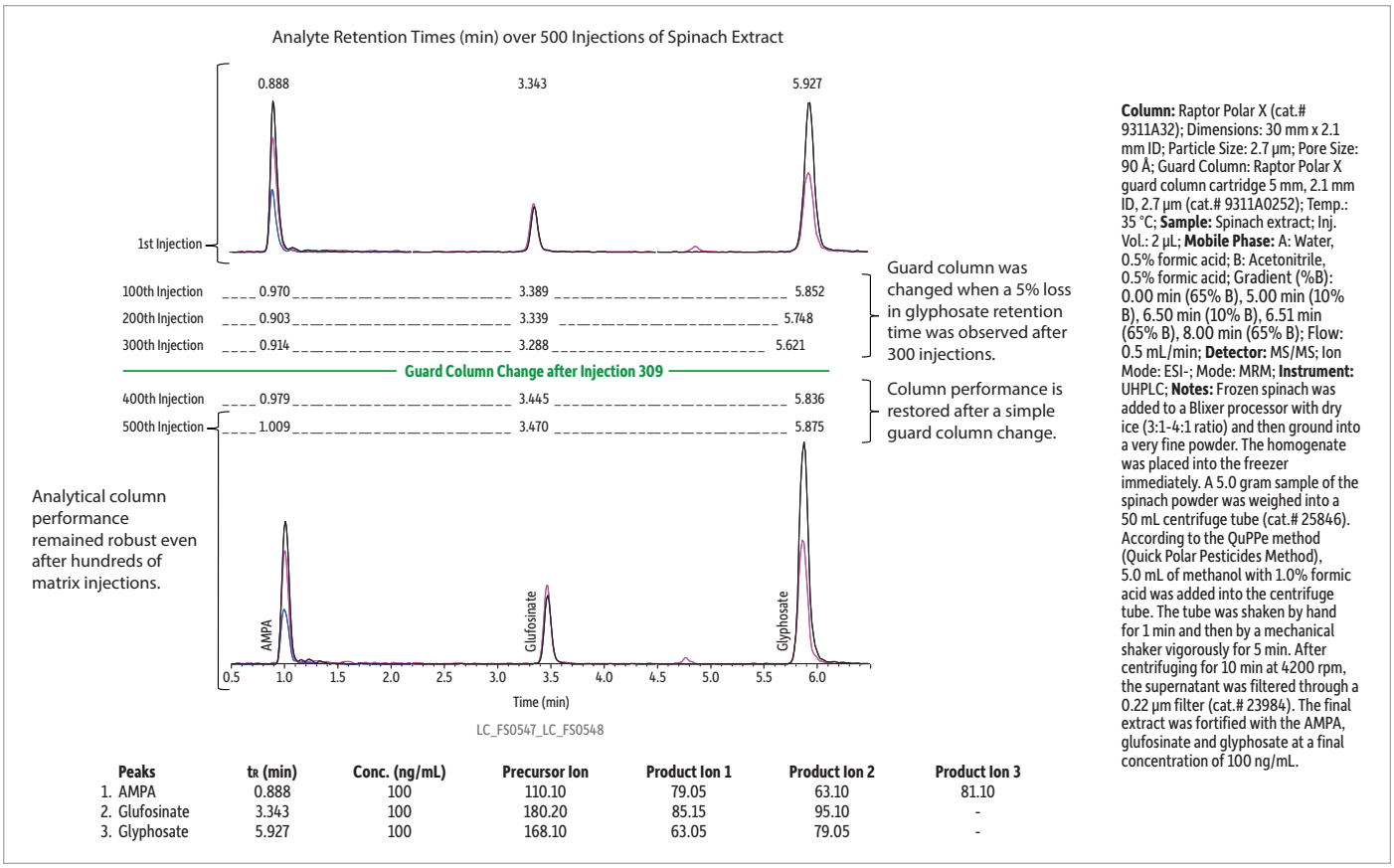
***Featured Application:*** *Polar Pesticides in Spinach on Raptor Polar X by LC-MS/MS*

# Fast and Rugged Direct Analysis of Polar Pesticides in Spinach

- No time-consuming derivatization, ion-pairing steps, or long waits for column equilibration.
- Unique stationary phase provides good retention and efficient elution, resulting in better peak shape.
- Robust column performance ensures consistent chromatography and reliable results.

The direct analysis of polar pesticides, such as glyphosate, its main metabolite AMPA, and glufosinate, is difficult because they are not retained well on reversed phase columns, and chelation with metal surfaces in the LC-MS/MS can significantly reduce response. Derivatization and ion-pairing reagents are often used to improve performance, but they require additional sample preparation time and can produce unfavorable side effects (precipitates, long equilibration times, system contamination, etc.).

Using a Raptor Polar X column is a better solution because the novel stationary phase offers stronger interaction with polar anionic compounds. It features hybrid retention modes (HILIC and ion exchange) and provides strong retention yet allows analytes to be quickly eluted as symmetrical peaks through simple mobile phase changes. In this analysis of polar pesticides in spinach, excellent chromatographic performance is seen for all three compounds with a total analysis time of just eight minutes. Further, peak shapes and retention times remain stable over hundreds of matrix injections, and a simple guard column change restores full performance. This fast, simple, and effective workflow is a good alternative for food labs interested in the direct analysis of polar pesticides without the need for complex and time-consuming procedures.




| Peaks | $t_R$ (min) | Conc. (ng/mL) | Precursor Ion | Product Ion 1 | Product Ion 2 | Product Ion 3 |
|---|---|---|---|---|---|---|
| 1. AMPA | 0.888 | 100 | 110.10 | 79.05 | 63.10 | 81.10 |
| 2. Glufosinate | 3.343 | 100 | 180.20 | 85.15 | 95.10 | - |
| 3. Glyphosate | 5.927 | 100 | 168.10 | 63.05 | 79.05 | - |

**Column:** Raptor Polar X (cat.# 9311A32); Dimensions: 30 mm x 2.1 mm ID; Particle Size: 2.7 µm; Pore Size: 90 Å; Guard Column: Raptor Polar X guard column cartridge 5 mm, 2.1 mm ID, 2.7 µm (cat.# 9311A0252); Temp.: 35 °C; **Sample:** Spinach extract; Inj. Vol.: 2 µL; **Mobile Phase:** A: Water, 0.5% formic acid; B: Acetonitrile, 0.5% formic acid; Gradient (%B): 0.00 min (65% B), 5.00 min (10% B), 6.50 min (10% B), 6.51 min (65% B), 8.00 min (65% B); Flow: 0.5 mL/min; **Detector:** MS/MS; Ion Mode: ESI-; Mode: MRM; **Instrument:** UHPLC; **Notes:** Frozen spinach was added to a Blixer processor with dry ice (3:1–4:1 ratio) and then ground into a very fine powder. The homogenate was placed into the freezer immediately. A 5.0 gram sample of the spinach powder was weighed into a 50 mL centrifuge tube (cat.# 25846). According to the QuPPe method (Quick Polar Pesticides Method), 5.0 mL of methanol with 1.0% formic acid was added into the centrifuge tube. The tube was shaken by hand for 1 min and then by a mechanical shaker vigorously for 5 min. After centrifuging for 10 min at 4200 rpm, the supernatant was filtered through a 0.22 µm filter (cat.# 23984). The final extract was fortified with the AMPA, glufosinate and glyphosate at a final concentration of 100 ng/mL.

## Featured Products

| Reference Standards | Sample Handling | Analytical Column | Maintenance/Accessories |
|---|---|---|---|
|  |  |  |  |
| **Glyphosate**<br>cat.# 32426 & 32427 | **50 mL centrifuge tubes**<br>cat.# 25846<br>**Syringe filter**<br>**30 mm x 0.22 µm**<br>cat.# 23984 | **2.7 µm, 30 x 2.1 mm**<br>**Raptor Polar X column**<br>cat.# 9311A32 | **Passivation solution**<br>cat.# 32475<br>**Raptor Polar X**<br>**guard column**<br>cat.# 9311A0252<br>**EXP direct connect holder**<br>cat.# 25808 |

### Glyphosate Standard

Glyphosate (N-(phosphonomethyl)glycine) (1071-83-6)

| Description | CAS # | Conc. in Solvent | cat.# |
|---|---|---|---|
| Glyphosate | 1071-83-6 | 1,000 µg/mL in DI water, 1 mL/ampul | 32426 (ea.) |
| | 1071-83-6 | 1,000 µg/mL in DI water, 5 mL/ampul | 32427 (ea.) |

### LC Passivation Solution

Methylenediphosphonic Acid (Medronic Acid) (1984-15-2)

| Description | CAS # | Conc. in Solvent | cat.# |
|---|---|---|---|
| Methylenediphosphonic Acid (Medronic Acid) | 1984-15-2 | 1,760 µg/mL, Methanol (HPLC grade)/Water (50:50), 1mL/ampul | 32475 (ea.) |

25846

### Empty Centrifuge Tubes, Polypropylene

| Description | qty. | cat.# |
|---|---|---|
| Empty 50 mL Centrifuge Tube, Polypropylene w/Blue Cap | 50-pk. | 25846 |

23984

### Syringe Filters with Luer Lock Inlet

- Luer lock inlet offers leak-tight syringe connection.
- Autoclavable to 121 °C for 15 minutes.
- Quantity break pricing for greater savings.

| Description | Color | Diameter | Porosity | qty. | cat.# |
|---|---|---|---|---|---|
| PTFE (polytetrafluoroethylene) | White | 30 mm | 0.22 µm | 100-pk. | 23984 |

PTFE—hydrophobic applications. Syringe filters are for laboratory use only.

## Raptor Polar X LC Columns


- Reliably analyze a wide variety of polar analytes (acidic, basic, and neutral) without time-consuming derivatization or complex ion pairing.
- Switch between HILIC and ion-exchange retention modes with simple mobile phase changes and short equilibration times.
- 2.7 µm Raptor core-shell particles provide UHPLC-like speed and efficiency on all makes and models of LC systems.
- Ideal for increasing sensitivity and selectivity in LC-MS analyses.

| ID | Length | qty. | cat.# |
|---|---|---|---|
| **2.7 µm Particles** | | | |
| 2.1 mm | 30 mm | ea. | 9311A32 |
| | 50 mm | ea. | 9311A52 |
| | 100 mm | ea. | 9311A12 |

## Raptor EXP Guard Column Cartridges

- Free-Turn architecture lets you change cartridges by hand without breaking inlet/outlet fluid connections—no tools needed.
- Patented titanium hybrid ferrules can be installed repeatedly without compromising high-pressure seal.
- Auto-adjusting design provides ZDV (zero dead volume) connection to any 10-32 female port.
- Guard column cartridges require EXP direct connect holder (cat.# 25808).

9311A0252

| Description | Particle Size | Size | qty. | cat.# |
|---|---|---|---|---|
| Raptor Polar X EXP Guard Column Cartridge | 2.7 µm | 5 x 2.1 mm | 3-pk. | 9311A0252 |

Maximum cartridge pressure: 600 bar/8,700 psi (2.7 µm)

Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.

## EXP Direct Connect Holder

| Description | qty. | cat.# |
|---|---|---|
| EXP Direct Connect Holder for EXP Guard Cartridges (includes hex-head fitting & 2 ferrules) | ea. | 25808 |

Maximum holder pressure: 20,000 psi (1,400 bar)

Hybrid Ferrule U.S. Patent No. 8201854, EXP Holders U.S. Patent No. 8696902, EXP2 Wrench U.S. Patent No. D766055. Other U.S. and Foreign Patents Pending. The EXP, Free-Turn, and the Opti- prefix are registered trademarks of Optimize Technologies, Inc.

25808

## Related Products

26431

### Bluestem Glass Solvent Filter

Prevent the particulates and microbial growth in your LC solvents from entering your instrument with the new Restek Bluestem glass solvent filter.

| Description | qty. | cat.# |
|---|---|---|
| Frit Adaptor, PTFE | 4-pk. | 26392 |
| Glass Solvent Filter, 15 µm frit | ea. | 26431 |

25322

### Survival Kit for HPLC, PEEK

For start-up and maintenance in all HPLC systems.

The PEEK Survival Kit is an invaluable parts kit that contains tubing, fittings, and tools essential for setting up and maintaining your HPLC system: PEEK tubing, connectors, and elbows; PTFE tubing; a tubing cutter and extra blades; a ValvTool wrench; open-end wrenches; and more.

| Description | qty. | cat.# |
|---|---|---|
| Survival Kit for HPLC | kit | 25322 |

*Kit contains 1 wrench, replacement (cat.# 20110) is a 2-pk.

23243

### Limited-Volume 2.0 mL, 9 mm Screw-Thread Polypropylene Vials

- Fit all 2.0 mL, 12 x 32 mm, vial-based autosamplers.
- Compatible with all 9 mm screw-thread caps.
- PTFE-free—ideal for PFAS analysis (e.g., EPA 537) and other PFAS-sensitive methods.

Note: Polypropylene vials and caps prevent sample contamination from PTFE coated septa. However, since polypropylene caps do not reseal, evaporation occurs after injection. Multiple injections from the same vial are therefore not possible.

| Description | Type | Volume | Color | Size | qty. | cat.# |
|---|---|---|---|---|---|---|
| Limited-Volume 2.0 mL, 9 mm Screw-Thread Polypropylene Vials | 9 mm Screw-Thread | 700 µL | Clear | 12 x 32 mm | 100-pk. | 23243 |
| | 9 mm Screw-Thread | 700 µL | Clear | 12 x 32 mm | 1,000-pk. | 23246 |

24669

### 2.0 mL, 9 mm Short-Cap, Screw-Vial Closures (Polypropylene, preassembled)

| Description | Type | Cap Size | Color | Septa Material | qty. | cat.# |
|---|---|---|---|---|---|---|
| Short Screw Caps | Screw-Thread | 9-425 | Blue | PTFE/Silicone | 100-pk. | 24485 |
| | Screw-Thread | 9-425 | Blue | PTFE/Silicone | 1,000-pk. | 24486 |
| | Screw-Thread | 9-425 | Green | PTFE/Silicone | 100-pk. | 24487 |
| | Screw-Thread | 9-425 | Green | PTFE/Silicone | 1,000-pk. | 24488 |
| | Screw-Thread | 9-425 | Yellow | PTFE/Silicone | 100-pk. | 24493 |
| | Screw-Thread | 9-425 | Yellow | PTFE/Silicone | 1,000-pk. | 24494 |
| | Screw-Thread | 9-425 | Mixed | PTFE/Silicone | 500-pk. | 24669 |

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**Questions? Contact us or your local Restek representative (www.restek.com/contact-us).**



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