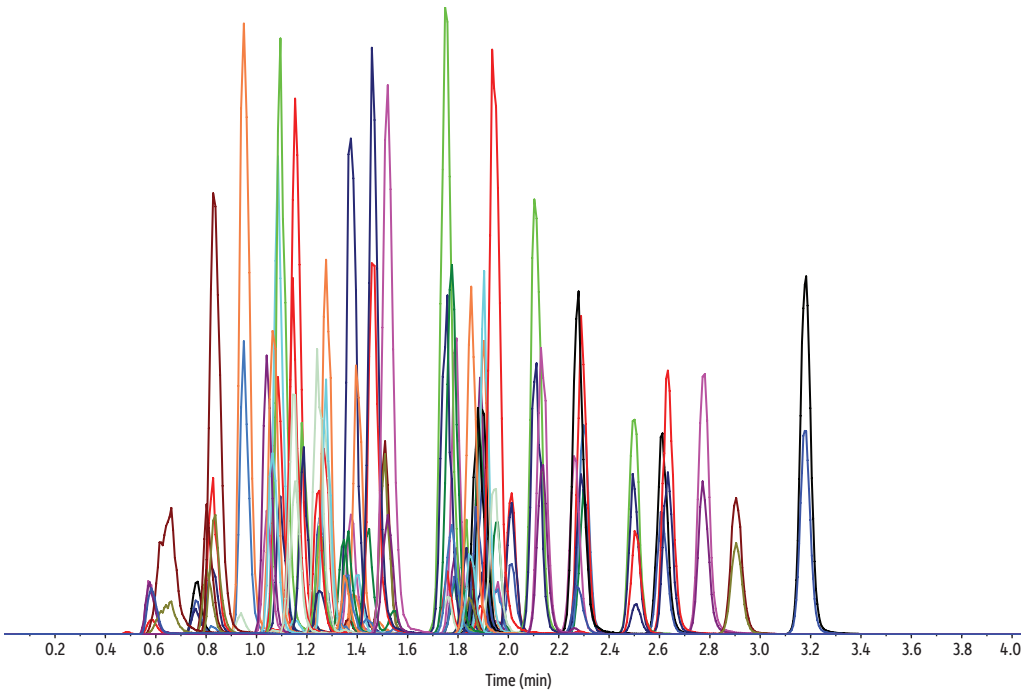
Featured Application: *Mental Health Drugs on Raptor Biphenyl*

LC-MS/MS Analysis of 58 Antipsychotics and Antidepressants in Human Urine

- Simple sample preparation procedure and fast, 5.5-min total LC cycle time.
- Good chromatographic separation of isobaric compounds.
- Optimized method suitable for quantitative analysis.

Mental health disorders contribute significantly to worldwide morbidity and mortality, a fact reflected in the growing numbers of new antipsychotic and antidepressant drugs entering the market, as well as the rising rate of prescription. These drugs, which are used to treat a wide range of psychiatric disorders, such as schizophrenia, bipolar disorder, dysthymia, social anxiety disorder, obsessive-compulsive disorder, and chronic pain, have a high potential for abuse. In the forensic setting, detection of these drugs is critical in determining their involvement in intoxications and suicides. In the clinical setting, analysis of antipsychotics and antidepressants in blood or urine is necessary to ensure suitable therapeutic concentration and to monitor patient compliance.

By combining a simple sample preparation procedure and a fast LC-MS/MS analysis of antipsychotics and antidepressants using a Raptor Biphenyl column, a highly specific and accurate method was established for 58 drugs in human urine. Chromatographic carryover, initially problematic, was resolved by rinsing the injector and needle both externally and internally with a 50:50 methanol:DMSO solution. This, coupled with a highly organic initial mobile phase, ensured the chromatographic separation of isobaric compounds (maprotiline and amitriptyline; protriptyline and nortriptyline) needed for quantitative analysis. Under the conditions shown here, a fast, efficient separation was achieved for the simultaneous LC-MS/MS analysis of antipsychotics and antidepressants with a 3.5 minute gradient and a 5.5 minute total LC cycle time.



LC_CF0749

Peaks	tR (min)	Conc. (ng/mL)	Precursor Ion	Product Ion	Product Ion
1. Desmethylolanzapine	0.58	2500	299.1	256.1	198.0
2. Phenelzine sulfate	0.59	2500	137.2	105.1	77.1
3. Olanzapine	0.65	2500	313.2	256.1	198.1
4. Lamotrigine	0.76	2500	256.0	211.1	145.0
5. Molindone	0.81	2500	278.1	100.3	101.1
6. (+/-)-Hydroxybupropion	0.83	2500	256.0	130.2	166.0
7. 7-Hydroxyquetiapine	0.84	2500	400.3	269.0	208.0
8. Bupropion-D9 (IS)	0.94	200	249.2	130.9	-
9. Bupropion	0.95	2500	240.0	184.1	130.2
10. Venlafaxine	1.04	2500	278.4	260.4	121.2
11. Reduced haloperidol	1.07	2500	378.1	359.9	109.1
12. Milnacipran	1.09	2500	247.2	100.1	129.1
13. N-desmethylmirtazapine	1.10	2500	252.1	195.1	209.2
14. 9-Hydroxyrisperidone	1.15	2500	427.3	207.1	110.2
15. Mirtazapine	1.16	2500	266.1	195.1	72.1
16. N-desmethylclozapine	1.19	2500	313.0	192.1	270.0
17. Droperidol	1.24	2500	380.1	122.9	165.1
18. Clozapine	1.25	2500	328.2	271.1	193.1
19. Didesmethyl citalopram	1.26	2500	297.1	109.1	261.9
20. N-desmethylcitalopram	1.27	2500	311.1	109.1	262.1
21. Escitalopram	1.28	2500	325.3	109.1	261.9
22. Fluvoxamine	1.35	2500	319.1	71.2	130.1
23. Haloperidol	1.36	2500	377.2	123.0	95.1
24. Norfluoxetine	1.37	2500	296.3	134.3	104.9
25. Isocarboxazid	1.38	2500	232.0	91.1	65.2
26. Fluoxetine	1.39	2500	310.1	148.0	115.1
27. Desmethyldoxepin	1.40	2500	266.1	107.1	115.0
28. Doxepin	1.45	2500	280.1	107.2	77.1
29. Trazodone	1.46	2500	372.3	176.1	148.0
30. Oxcarbazepine	1.51	2500	253.1	180.0	208.1
31. Risperidone	1.52	2500	411.2	191.0	110.1
32. Quetiapine	1.75	2500	384.2	253.0	221.2
33. Asenapine	1.76	2500	286.2	165.1	229.1
34. Ziprasidone	1.78	2500	413.2	194.1	130.0
35. Protriptyline	1.79	2500	264.1	191.1	165.2
36. Desipramine	1.83	2500	267.1	72.1	193.1
37. Paroxetine	1.85	2500	330.2	192.2	70.1
38. Iloperidone	1.85	2500	427.1	261.1	96.1
39. Duloxetine	1.86	2500	298.1	188.2	154.1
40. Amoxapine	1.88	2500	314.2	271.0	193.1
41. Carbamazepine	1.89	2500	237.0	193.9	192.0
42. Maprotiline	1.90	2500	278.1	250.2	191.1
43. Imipramine	1.91	2500	281.1	86.2	58.1
44. Nortriptyline	1.95	2500	264.1	91.1	115.2
45. Loxapine	1.95	2500	328.1	271.1	193.0
46. Amitriptyline	2.01	2500	278.1	91.1	202.1
47. Trimipramine	2.11	2500	295.2	100.2	58.2
48. Pimozide	2.13	2500	462.1	328.0	109.1
49. Chlorpromazine	2.26	2500	319.0	86.1	178.2
50. Dehydro aripiprazole	2.28	2500	446.2	285.0	98.1
51. Clomipramine	2.29	2500	315.3	86.0	58.0
52. Sertraline	2.30	2500	306.2	275.1	158.9
53. Fluphenazine	2.50	2500	438.3	171.1	143.2
54. Aripiprazole	2.51	2500	448.2	285.0	176.1
55. Perphenazine	2.61	2500	404.2	171.1	143.2
56. Trifluoperazine	2.63	2500	408.2	141.2	113.1
57. Prochlorperazine	2.78	2500	374.1	141.0	113.1
58. Thiothixene	2.91	2500	444.2	221.2	235.0
59. Thioridazine	3.18	2500	371.2	126.1	98.1

Column
Dimensions: 50 mm x 3.0 mm ID
Particle Size: 2.7 µm
Pore Size: 90 Å
Guard Column: Raptor Biphenyl EXP guard column cartridge 5 mm, 3.0 mm ID, 2.7 µm (cat.# 9309A0253)
Temp.: 30 °C

Sample
Conc.: 2500 ng/mL
Inj. Vol.: 2 µL

Mobile Phase
A: Water, 0.1% formic acid, 5 mM ammonium formate
B: Methanol, 0.1% formic acid, 5 mM ammonium formate

Time (min)	Flow (mL/min)	%A	%B
0.00	0.6	40	60
0.20	0.6	40	60
3.50	0.6	0	100
3.51	0.6	40	60
5.50	0.6	40	60

Detector MS/MS
Ion Mode: ESI+
Mode: MRM
Instrument UHPLC

Notes
Drug-free human urine (BioIVT) was fortified with 58 analytes at 2500 ng/mL. Bupropion-D9 was used as the internal standard for quantification of all 58 compounds. The urine sample (50 µL) was mixed with 15 µL of IMCSzyme, 20 µL of reaction buffer, and 10 µL of internal standard solution (1 µg/mL in methanol). Hydrolysis was performed at 45°C (water bath) for 30 minutes, and then 400 µL of acetonitrile was added, vortexed to mix, and centrifuged at 4000 rpm for 10 minutes. The supernatant was diluted 2-fold with water and injected for analysis.

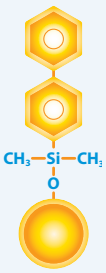
Raptor Biphenyl LC Columns (USP L11)

Chromatographic Properties

The innovative Biphenyl is Restek's most popular LC stationary phase because it is particularly adept at separating compounds that are hard to resolve or that elute early on C18 and other phenyl chemistries. As a result, the rugged Raptor Biphenyl column is extremely useful for fast separations in bioanalytical testing applications like drug and metabolite analyses, especially those that require a mass spectrometer (MS). Increasing retention of early-eluting compounds can limit ionization suppression, and the heightened selectivity helps eliminate the need for complex mobile phases that are not well suited for MS detection.

Length	2.1 mm cat.#	3.0 mm cat.#	4.6 mm cat.#
1.8 µm Columns			
30 mm	9309232	—	—
50 mm	9309252	930925E	—
100 mm	9309212	930921E	—
150 mm	9309262	—	—
2.7 µm Columns			
30 mm	9309A32	9309A3E	9309A35
50 mm	9309A52	9309A5E	9309A55
100 mm	9309A12	9309A1E	9309A15
150 mm	9309A62	9309A6E	9309A65
5 µm Columns			
30 mm	—	930953E	—
50 mm	9309552	930955E	9309555
100 mm	9309512	930951E	9309515
150 mm	9309562	930956E	9309565
250 mm	—	—	9309575

Column Characteristics:



- Stationary Phase Category: Phenyl (L11)
- Ligand Type: Biphenyl
- Particle: 1.8 µm, 2.7 µm, or 5 µm superficially porous silica (SPP or "core-shell")
- Pore Size: 90 Å
- Carbon Load: 7% (1.8 µm), 7% (2.7 µm), 5% (5 µm)
- End-Cap: yes
- Surface Area: 125 m^2/g (1.8 µm), 130 m^2/g (2.7 µm), or 100 m^2/g (5 µm)
- Recommended Usage:
  - pH Range: 2.0 to 8.0
  - Maximum Temperature: 80 °C
  - Maximum Pressure: 1,034 bar/15,000 psi* (1.8 µm), 600 bar/8,700 psi (2.7 µm); 400 bar/5,800 psi (5 µm)

* For maximum lifetime, recommended maximum pressure for 1.8 µm particles is 830 bar/12,000 psi.

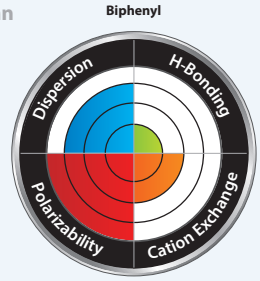
Properties:

- Increased retention for dipolar, unsaturated, or conjugated solutes.
- Enhanced selectivity when used with methanolic mobile phase.
- Ideal for increasing sensitivity and selectivity in LC-MS analyses.

Switch to a Biphenyl when:

- Limited selectivity is observed on a C18.
- You need to increase retention of hydrophilic aromatics.

USLC Column Interaction Profile



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.

To help protect your investment and further extend the life of our already-rugged LC columns, Restek offers the patent-pending guard column hardware developed by Optimize Technologies. A Restek LC guard cartridge in an EXP direct connect holder is the ultimate in column protection, especially when using dilute-and-shoot or other limited-sample preparation techniques.

Description	Particle Size	qty.	5 x 2.1 mm cat.#	5 x 3.0 mm cat.#	5 x 4.6 mm cat.#
Raptor Biphenyl EXP Guard Column Cartridge	2.7 µm	3-pk.	9309A0252	9309A0253	9309A0250

Maximum cartridge pressure: 1,034 bar/15,000 psi* (UHPLC), 600 bar/8,700 psi (2.7 µm); 400 bar/5,800 psi (5 µm)

* For maximum lifetime, recommended maximum pressure for UHPLC particles is 830 bar/12,000 psi.

RESTEK
Pure Chromatography

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

www.restek.com

QUALITY ISO 9001 • 17025 • 17034

Lit. Cat.# CFSS3051-UNV