

Simultaneous Determination of Estrogenic and Androgenic Hormones in Water by Isotope Dilution GC-Tandem MS using the Agilent 7000B Triple Quadrupole GC/MS

ENVIRONMENTAL ANALYSIS



The Agilent 7000B Triple Quadrupole GC/MS enables a rapid, highly sensitive, and highly reproducible method for 12 estrogenic and androgenic hormones.

Estrogenic and androgenic steroid hormones are environmental contaminants of increasing regulatory concern and attention. They are excreted by humans and animals and transferred to surface water by discharging treated municipal wastewaters or through agricultural run-off. An estrogenic contraceptive drug (17 α -ethynylestradiol) has been shown to result in localized extinction of some fish species due to reproductive disruption at concentrations of only 5–6 ng/L. Sensitive and reproducible methods are required to monitor the levels of these important contaminants.

A unique method has been developed at the UNSW Water Research Center, Australia, for the simultaneous determination of water-borne estrogenic and androgenic hormones on the Agilent 7000B Triple Quadrupole GC/MS¹. This Environmental Analysis flyer describes the key performance parameters of the method; a copy of the full research report in the *Journal of Chromatography A* can be obtained from the Agilent web site.

Water samples are extracted by solid phase extraction (SPE) followed by derivatization, and then analyzed by GC/MS/MS using either isotopically-labeled analogs or satisfactory isotope standards. All the analytes can be monitored in a single 15 minute GC/MS/MS run. The method was tested on four water sources, from drinking water to treated wastewater effluent. Most method recoveries ranged between 90 and 106%, even in treated wastewater. Method detection limits were in the range of 1–5 ng/L for most analytes in all four water sources. The method is also highly reproducible, with coefficients of variation (CVs) that range from 1 to 6% intraday and 2 to 10% interday for treated wastewater.

The Agilent 7000B Triple Quadrupole GC/MS provides sensitivity, selectivity, and instrument stability to enable highly accurate, reproducible, and simultaneous determination of hormones, even in treated wastewater.

1. T. Trinh, N. B. Harden, H. M. Coleman, and S. J. Khan, Simultaneous determination of estrogenic and androgenic hormones in water by isotope dilution gas chromatography–tandem mass spectrometry, *J. Chromatogr. A* **1218** 1668–1676 (2011).

Key Benefits

- Simultaneous analysis of both androgenic and estrogenic hormones
- 15 minute run time
- Most method recoveries \geq 90%
- Most MDLs in the 1–5 ng/L range
- Intraday method coefficients of variation (CVs) \leq 6% and inter-day CVs \leq 10%, even for treated wastewater



Table 1. Method Recoveries and Detection Limits for Analysis of Four Water Sources

Analytes	Method Recoveries					Method Detection Limits (MDLs)				
	Ultrapure water (n = 9)	Drinking water (n = 9)	MBR effluent (n = 9)	Surface water (n = 9)	Tertiary treated effluent (n=3)	Ultrapure water (n = 7)	MBR effluent (n = 7)	Drinking water (n = 7)	Surface water (n = 7)	Tertiary treated effluent (n=7)
Androsterone	110 (±10)	104 (±3)	105 (±4)	103 (±6)	114 (±4)	1.0	1.0	1.0	1.2	1.4
Etiocholanolone	101 (±5)	98 (±3)	97 (±3)	106 (±5)	100 (±7)	5.0	5.0	5.0	5.8	6.4
Dihydrotestosterone	98 (±5)	97 (±8)	92 (±7)	93 (±7)	95 (±7)	8.9	11.3	15.2	15.8	15.0
17 α -Estradiol	102 (±2)	101 (±2)	102 (±2)	106 (±5)	96 (±4)	0.8	0.9	1.2	0.9	1.0
Estrone	116 (±5)	100 (±4)	96 (±2)	100 (±4)	96 (±4)	0.7	0.7	0.7	0.7	0.8
Androstenedione	104 (±3)	105 (±3)	103 (±3)	105 (±7)	104 (±7)	5.0	5.0	5.0	5.0	5.5
17 β -Estradiol	100 (±2)	98 (±2)	94 (±3)	98 (±7)	98 (±6)	1.1	1.3	1.2	1.2	1.3
Testosterone	101 (±2)	100 (±4)	100 (±3)	104 (±4)	106 (±7)	5.0	5.0	5.0	5.0	6.0
Mestranol	90 (±15)	90 (±4)	84 (±2)	80 (±10)	86 (±10)	1.0	1.3	1.0	1.0	1.2
17 α -Ethinylestradiol	112 (±5)	88 (±4)	83 (±2)	81 (±5)	90 (±3)	1.0	1.0	1.0	1.3	1.2
Levonorgestrel	100 (±15)	100 (±8)	99 (±7)	107 (±7)	120 (±10)	5.0	6.0	7.5	5.0	7.0
Estriol	101 (±3)	92 (±5)	98 (±3)	94 (±5)	96 (±5)	2.5	2.5	2.5	2.6	3.0

± = Standard deviation

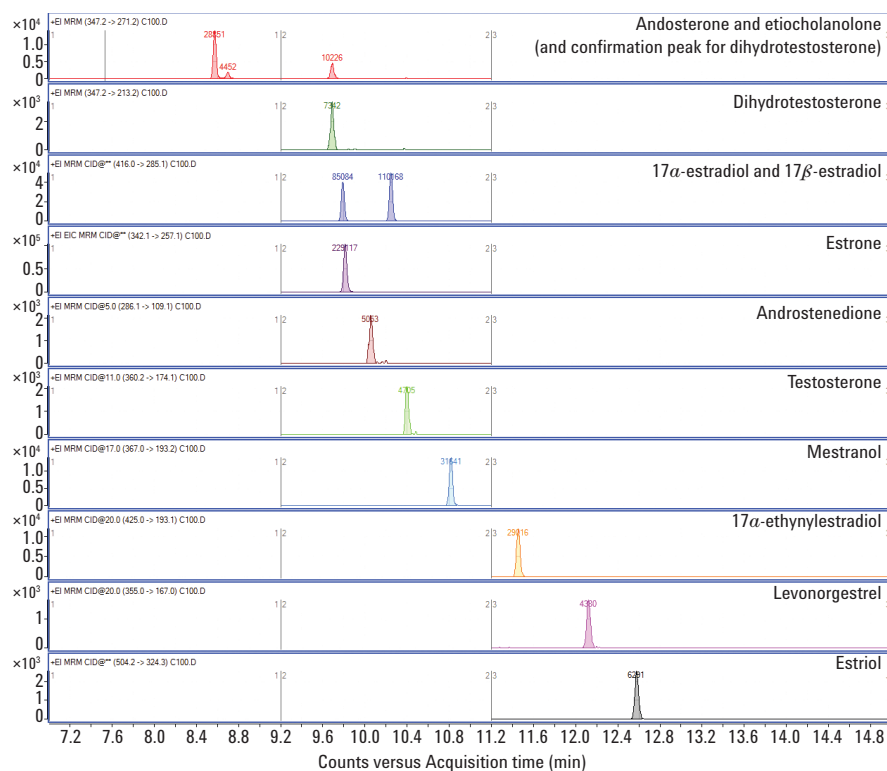


Figure 1. Chromatogram showing quantifier peaks for all 12 hormones.

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