APPLICATION BRIEF

Liquid Chromatography/ Mass Spectrometry

Authors:

Work completed by collaboration between PerkinElmer Seer Green, UK and Syngenta, Jealott's Hill, UK

A Comparison Between ESI and APCI Ionisation Modes

Introduction

Syngenta at Jealott's Hill International Research Centre, located in the United Kingdom, currently has LC mass spectrometers that can only be fitted with either an ESI or APCI source. Changing the source from ESI to APCI, and vice versa, involves cooling the source, manual removal and installation of the new source, followed by heating of the new source to the operating temperature, resulting in low throughput for analyses utilizing both ESI and APCI sources. For this reason, most analyses are performed using only an ESI source for ease of use and high throughput. When PerkinElmer made a QSight® 220, equipped with both ESI and APCI sources available to Syngenta, the usefulness of such an instrument for the routine screening of analytes was examined, with results presented herein.

QSight 220 Triple Quadrupole LC/MS/MS

PerkinElmer®
For the Better

Experimental

The PerkinElmer QSight 220, comprised of dual, independently operated ESI and APCI sources coupled to a PerkinElmer LX-50 liquid chromatography system, were evaluated for quick screening of analytes. Between the LC column and the mass spectrometer, a divert valve was installed that could send the LC column effluent to either the ESI or APCI source to check ionisation efficiency of different analytes with two different sources. All instrument control, data acquisition and data processing were performed using the Simplicity™ 3Q software platform.

The test mix of compounds utilized in this study, containing colchicine, reserpine, and terfenadine, was originally provided by BMSS (British Mass Spectrometry Society) for an interlaboratory study on ambient mass spectrometry. Other reagents used were acetonitrile (Fisher Scientific), formic acid (Sigma Aldrich) and water obtained using a Triple Red water purifier. A simple and fast LC gradient method (Tables 1 - 3) was used to separate the analytes and introduce them to the mass spectrometer. Samples containing different concentration levels of 50, 5 and 0.5 ng/mL were used to investigate the sensitivity of the different sources in both a clean solvent and a synthetic urine matrix.

Table 1. LC Method Parameters.

LC Column	C18	
Column Temperature	40 °C	
Mobile Phase A	Water + 0.1% Formic Acid	
Mobile Phase B	Acetonitrile + 0.1% Formic Acid	
Flow Rate	0.5 mL/min	
LC Mobile Phase Gradient		
Time (min)	Mobile Phase (A%)	Mobile Phase (B%)
	Water + 0.1% Formic Acid	Acetonitrile + 0.1% Formic Acid
0	90	10
0.5	90	10
3	10	90
3.9	10	90
4	90	10
5	90	10

Table 2. Analytes and their Masses for MRMs.

Analyte	Parent m/z	Daughter m/z
Colchicine	400.0	267.0
Terfenadine	472.0	436.0
Reserpine	609.0	195.0

Table 3. MS Source Parameters.

Parameter	Setting
Ionisation Polarity	Positive
Drying Gas	60
Nebulizer Gas	350
Electrospray Voltage	3000 V
Source Temperature	300 °C
Hsid Temperature	200 °C
Entrance Voltage	55 V
Collision Cell Lens 2	-100 V
Collision Energy	-50 V
Corona Discharge	5 µA
Dwell Time	100 ms

Chromatograms

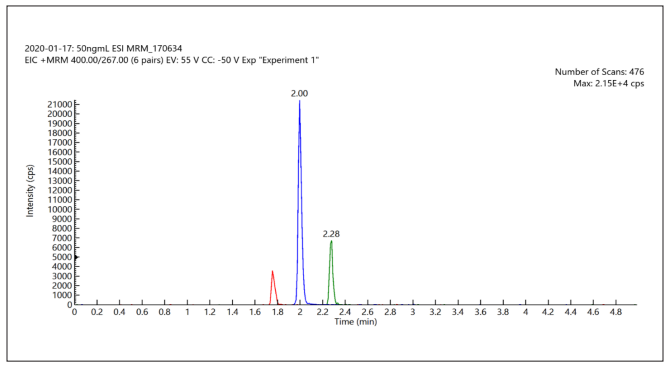

Figure 1. An overlay of MRM chromatograms of three compounds at 50 ng/mL with ESI source: colchicine in red, reserpine in blue, and terfenadine in green.

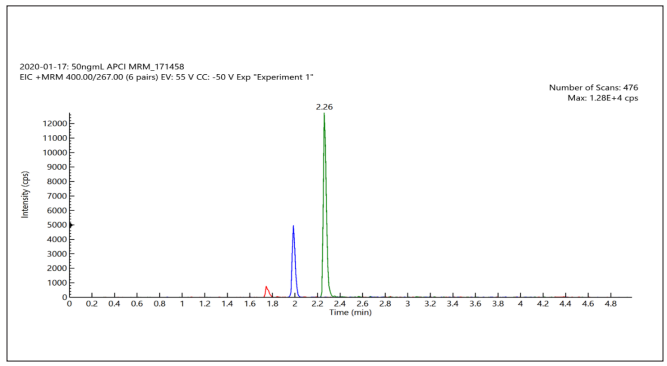

Figure 2. An overlay of MRM chromatograms of three compounds at 50 ng/mL with APCI source: colchicine in red, reserpine in blue, and terfenadine in green.

Results

As indicated in Table 4, colchicine was detected at 5 ng/mL using both the ESI and APCI sources. The response with the ESI source was more intense than the response obtained with the APCI source, where at both concentrations tested (50 and 5 ng/mL), the response was around 5x higher with ESI.

Table 4. Colchicine Results – Sample in Acetonitrile.

Concentration of Colchicine	Signal Intensity Ratio Between ESI:APCI
50 ng/mL	5.27
5 ng/mL	4.65
500 pg/ml	Not Detected

Reserpine was detected at the 500 pg/mL level using only the ESI source, as shown in Table 5, indicating a superior limit of detection when compared to the APCI source. Similar to colchicine, the ESI signal intensity was 5x higher compared to APCI.

Table 5. Reserpine Results – Sample in Acetonitrile.

Concentration of Reserpine	Signal Intensity Ratio Between ESI:APCI
50 ng/mL	4.85
5 ng/mL	5.02
500 pg/mL	Only Detected with ESI

The response results for Terfenadine (Table 6) with the APCI source showed a higher response by a factor of two in comparison to the ESI source.

Table 6. Terfenadine Results – Sample in Acetonitrile.

Concentration of Terfenadine	Signal Intensity Ratio Between ESI:APCI
50 ng/mL	0.59
5 ng/mL	0.56
500 pg/mL	Only Detected with APCI

The above results demonstrate the ability to check the response of compounds using both ESI and APCI sources, enabling the detection of different classes of compounds with higher sensitivity using both the ESI and APCI sources, instead of using only one source. It would therefore be beneficial to utilize an MS instrument that can automatically switch between ESI and APCI sources to maximize the sensitivity of different analytes with no down time or human interaction.

The ability of the PerkinElmer QSight 220's APCI source in handling a complex matrix was compared to another triple quadrupole mass spectrometer from an alternative vendor. The three analytes used in this study were spiked into a synthetic urine matrix at a level of 5 µg/mL, and then injected into both the PerkinElmer QSight 220 MS and the alternative instrument. All analytes showed ion suppression in both MS systems, as shown in Table 7. However, less ion suppression was observed when the samples were analysed on the QSight 220 MS, as compared to the other MS instrument. This is advantageous for analysis of compounds using QSight with dual ESI and APCI sources, as less signal suppression in the matrix will result in a lower limit of detection for the compounds.

Table 7. Ion Suppression.

Analyte	QSight 220 % Suppression	Alternative Instrument % Suppression
Colchicine	71%	73%
Terfenadine	55%	89%
Reserpine	57%	91%

Conclusion

This study demonstrates that the QSight 220, with its dual independent sources capable of measuring in both ESI and APCI modes, can cover different classes of compounds with lower limits of quantitation, even in a complex matrix. The ease with which the QSight 220 can switch between ESI and APCI sources allows users to rapidly check the response of different compounds with both the ESI and APCI source, and determine which source is most suitable for measuring an analyte with low sensitivity. The dual source capability with a switching valve reduces the time spent switching from ESI to APCI from around an hour, to virtually no time at all, and with no human intervention.

PerkinElmer, Inc.
940 Winter Street
Waltham, MA 02451 USA
P: (800) 762-4000 or
(+1) 203-925-4602
www.perkinelmer.com

PerkinElmer®

102580 PKI