Improved molecular detection and acquisition speed using DESI mass spectrometry imaging quadrupole based mass spectrometer

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Introduction

Desorption electrospray ionization (DESI™) mass spectrometry imaging (MSI) is typically known for the mapping of small molecules directly from tissue sections. DESI MSI has been proven to be successful when used on Time-Of-Flight (TOF) based mass spectrometers for untargeted analysis or mass spectral fingerprinting. Tandem quadrupole (TQ) mass spectrometers are renowned for their sensitivity and specificity for targeted applications using Single Ion Monitoring (SIR) or Multiple Reaction Monitoring (MRM) modes of acquisition.
In this study we aimed to investigate the level of detection and the effect of acquisition speed applied to the analysis of pharmaceutical compounds and metabolites in DESI imaging experiments on a quadrupole based mass spectrometer.

Experimental

1 µL of mixed solutions of Propanolol, Olanzapine, Erlotinib, Moxifloxacin, Terfenadine and Irinotecan were spotted on 16 µm porcine liver tissue sections covering the range 1 pg to 10,000 pg.
Mouse brain, kidney and liver tissue sections (orally dosed with Olanzapine (10 mg/kg), Erlotinib (10 mg/kg), Moxifloxacin (25 mg/kg) and Terfenadine (25 mg/kg) at control, 2 and 6 hours post dosed animals) were analysed with DESI XS source that was using a High-Performance DESI sprayer, mounted on a Xevo™ TQ-XS mass spectrometer in MRM mode and Xevo G2-XS Q-Tof mass spectrometer in MS mode (Waters, UK).
The implementation of the DESI XS on Xevo TQ-XS mass spectrometer has been developed using High Definition Imaging (HDI™) 1.6 software via a plugin, where the captured optical image is co-registered.

Results

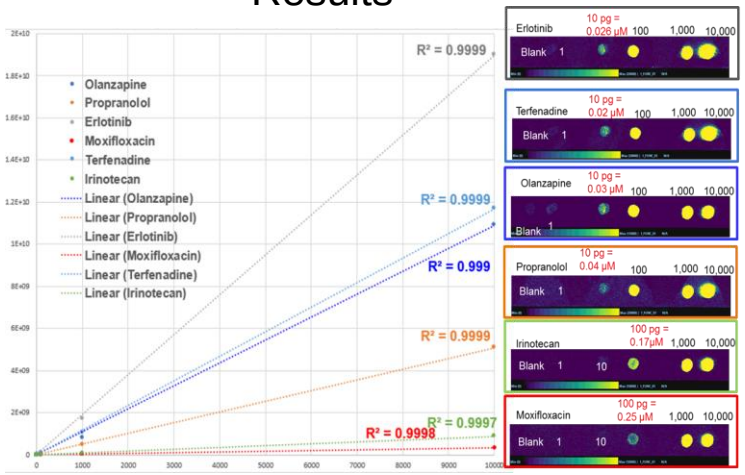


Figure 1. Calibration curve with DESI ion images of the ten-fold dilution series of Moxifloxacin, Irinotecan, Propranolol, Olanzapine, Erlotinib and Terfenadine on DESI XS Xevo TQ-XS mass spectrometer. 20 MRM were defined in the method. Acquisition was performed at 10 pixels per second.

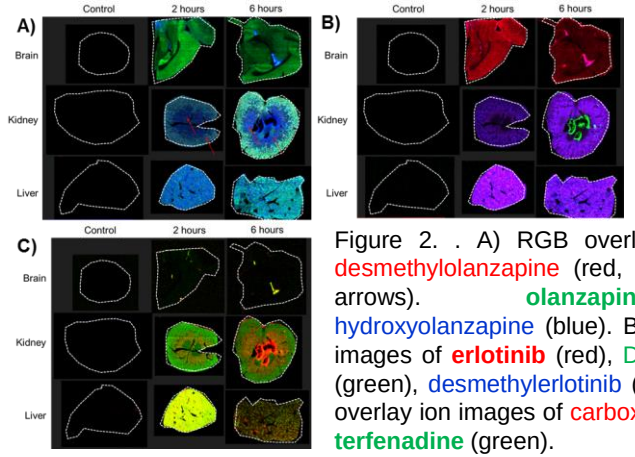
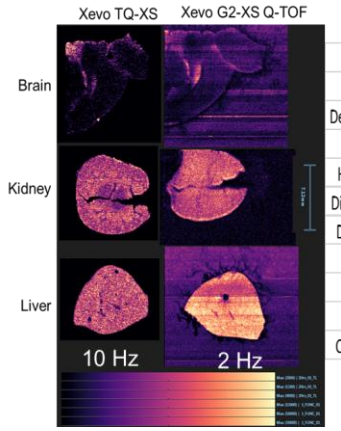


Figure 2. . A) RGB overlay ion images of desmethylolanzapine (red, highlighted by red arrows). **olanzapine** (green), hydroxyolanzapine (blue). B) RGB overlay ion images of **erlotinib** (red), Didesmethylerlotinib (green), desmethylerlotinib (blue) and C) RBG overlay ion images of carboxyterfenadine (red), **terfenadine** (green).



		Brain		Kidney		Liver	
	Precursor	TQ-XS	G2 Q-Tof XS	TQ-XS	G2 Q-Tof XS	TQ-XS	G2 Q-Tof XS
Desmethylolanzapine	299						
Olanzapine	**313**						
Hydroxyolanzapine	329						
Didesmethylerlotinib	366						
Desmethylerlotinib	380						
Erlotinib	**394**						
Moxifloxacin	**402**						
Terfenadine	**472**						
Carboxyterfenadine	502						

Figure 3. . Distribution of moxifloxacin drug compound in 2 hours post dosed brain, kidney and liver tissue sections, analysed by DESI on the Xevo TQ-XS (left) and Xevo G2-XS QTof (right). Table comparing the detection of the four drugs and five metabolites using the DESI XS on the Xevo TQ-XS in MRM mode and Xevo G2-Q-Tof XS in MS mode (**green**: detected, **red**: not detected).

Conclusions

All pharmaceutical compounds were detected at 10-100 pg on tissue with excellent linearity (figure 1).
Four drugs and five metabolites have been successfully imaged by MRM imaging using DESI XS with a Xevo TQ-XS tandem mass spectrometer (figure 2)
MRM imaging has enhanced level of detection due to the specificity of the method vs. untargeted MS method (figure 3) at high speed of acquisition,.

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