Mass Spectrometry Imaging of Drug Distribution in Mouse Tissue using SunCollect Sprayer and AP/MALDI UHR Coupled to a Q Exactive Orbitrap Mass Spectrometer

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Overview

- The SunCollect pneumatic sprayer and AP/MALDI UHR ion source, integrated with a Thermo Q Exactive Orbitrap mass spectrometer, enable high-resolution mass spectrometry imaging of biological tissues.
- This powerful setup allows precise detection and spatial visualization of drug distribution in tissue samples.

Introduction

Myxoid liposarcoma (MLS) is the second most common liposarcoma subtype, predominantly affecting deep soft tissues and characterized by a distinctive vascular structure and low cellularity. The marine alkaloid trabectedin and drugs of the thiazolidinedione class demonstrate promising efficacy against MLS, making it crucial to study drug distribution within tumors. Mass spectrometry imaging (MSI) is a valuable tool for visualizing therapeutic compounds in tissue, offering insights into treatment effectiveness and drug resistance mechanisms.

Methods

- MLS tumor and liver tissue sections were prepared at 10 µm thickness and mounted onto a stainless steel MALDI target plate.
- Sections were uniformly coated with α-Cyano-4-hydroxycinnamic acid (CHCA) matrix using the SunCollect sprayer.
- MSI data was acquired using the AP/MALDI UHR source coupled to the Thermo Q Exactive Orbitra in positive ion mode with high-resolution full scans.
- Data was exported in imzML format and processed using MSiReader software, normalizing drug ion signals to total ion current (TIC).

Key Words
High-resolution mass spectrometry imaging, AP/MALDI drug distribution imaging, Myxoid liposarcoma, spatial metabolomics

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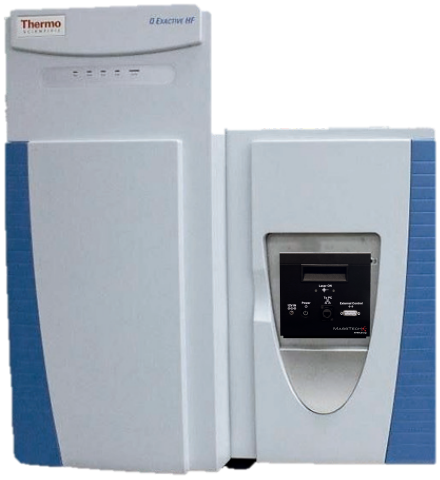
Results

The anti-cancer drug was clearly detected as a protonated molecular ion at m/z 357.124 in treated tissue sections, with no corresponding signal in untreated controls. Imaging data showed relatively uniform drug distribution across liver and tumor tissues, with a limit of detection around 0.1 pmol/spot across untreated control and tumor samples. Images acquired at 25 µm pixel size demonstrated detailed spatial mapping of the drug within the tissue microenvironment.



AP/MALDI with Thermo HRMS

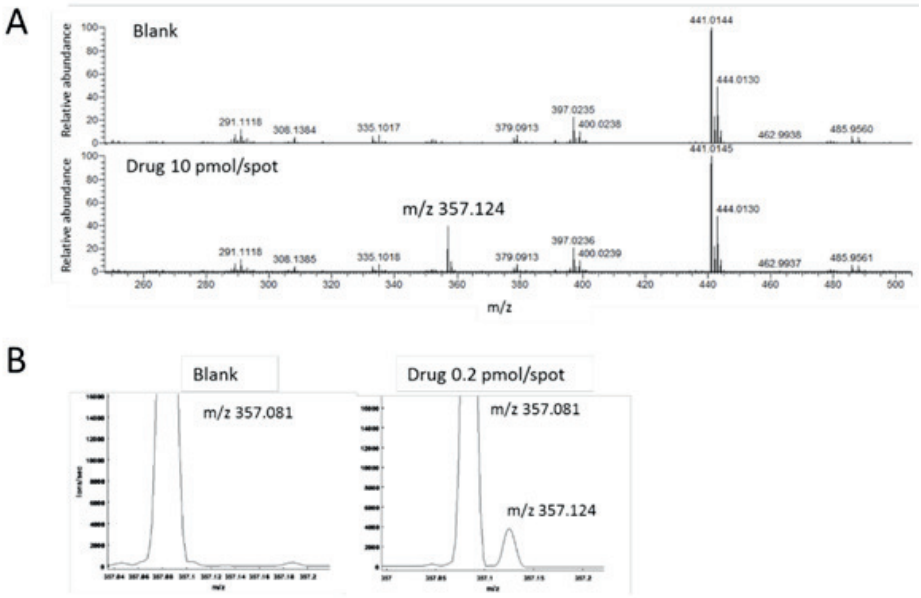


Figure 1: Representative mass spectra of untreated tissue sections and tissues spiked with the anti-tumor drug (A). Distinguishing drug ion from interfering peak in high-resolution MS (B).

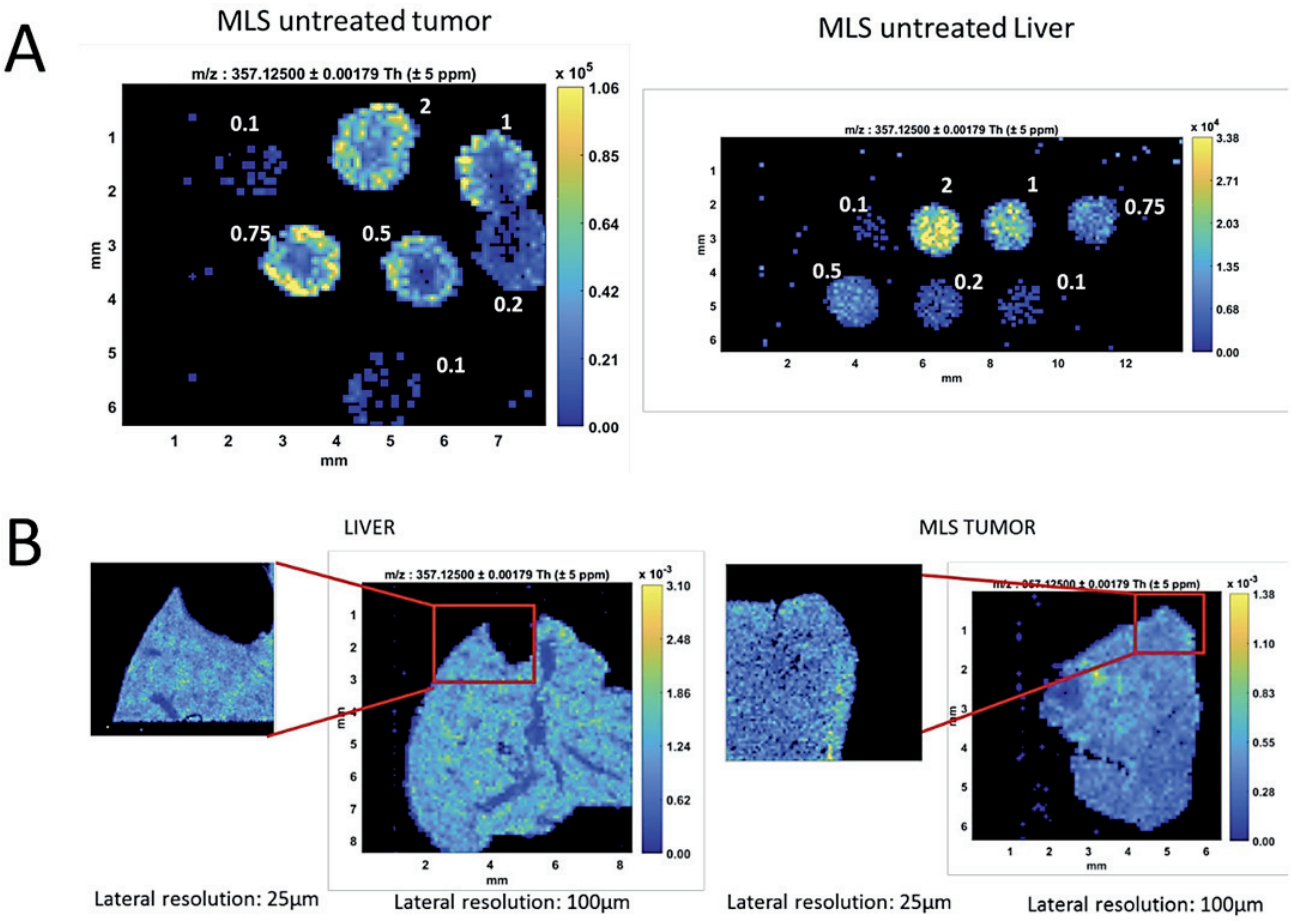


Figure 2: Detection of the anti-tumor drug spotted on untreated tissue sections at different concentrations (0.1 – 2 pmol/spot) (A) and MALDI-Imaging analysis of liver and tumor tissue sections (B)