

OVERVIEW & OBJECTIVES

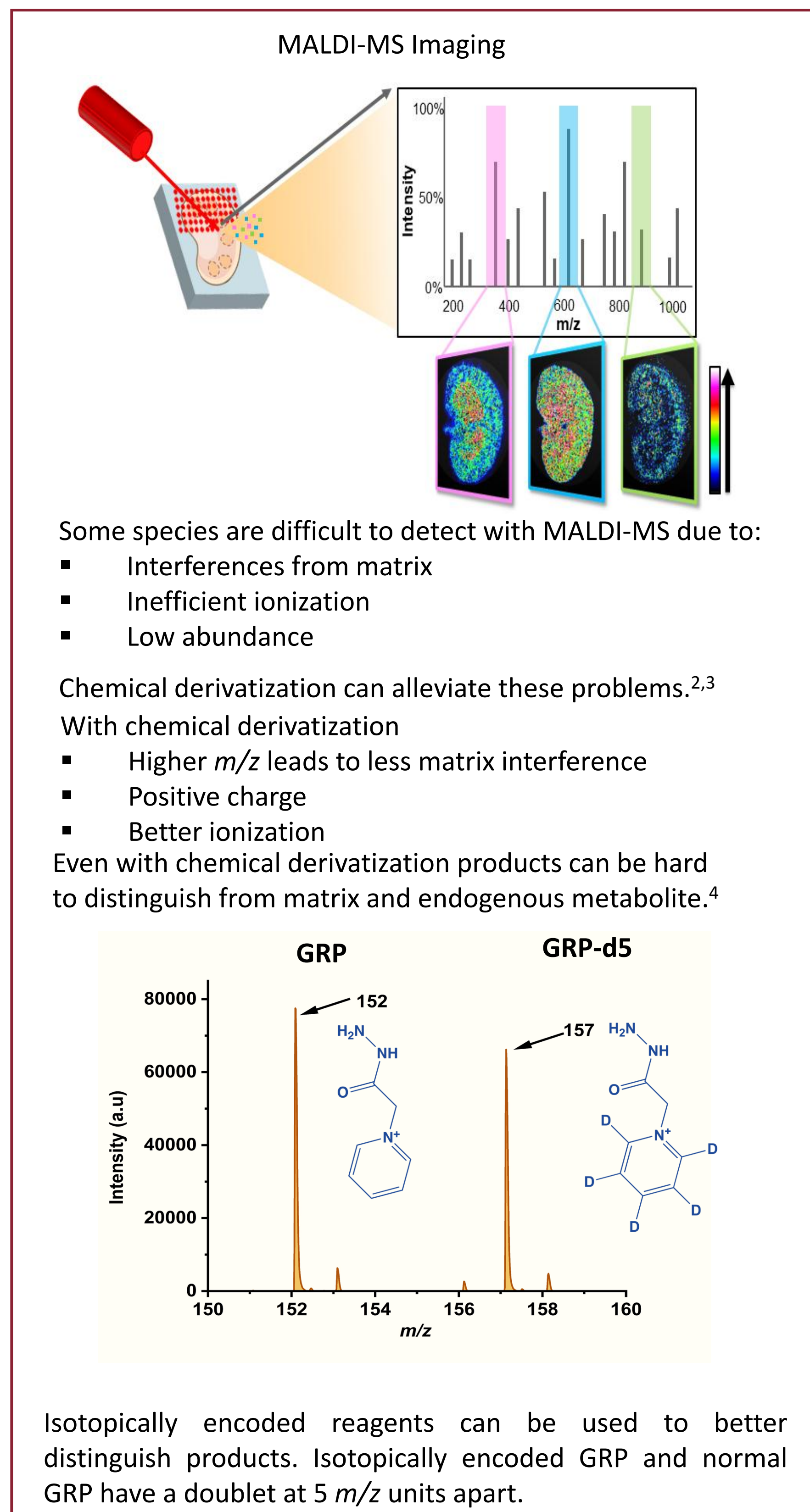
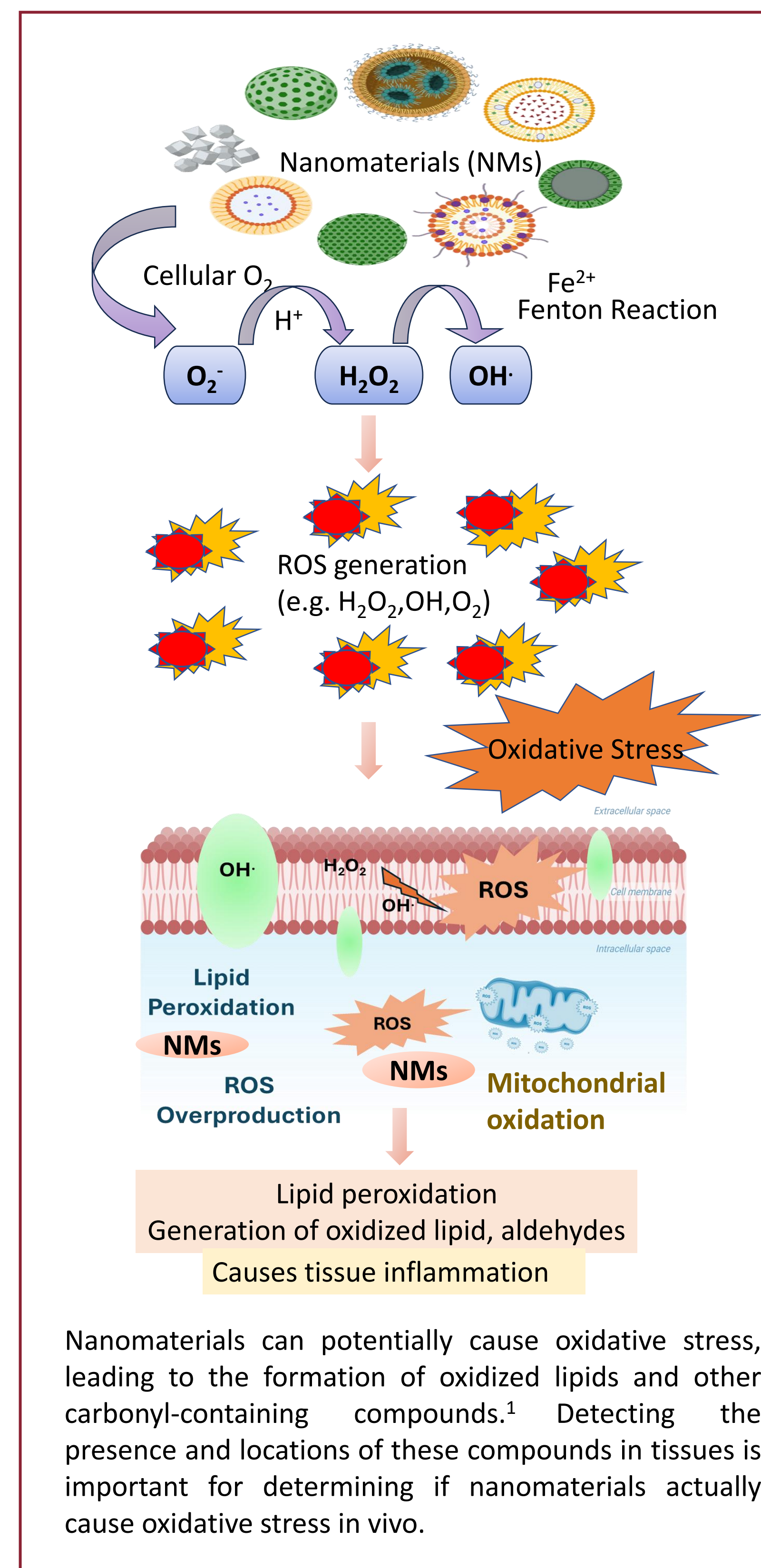
Detection of carbonyl compounds and oxidized lipids by MALDI-MS imaging in biological tissues is challenging due to poor ionization efficiency, chemical instability, and matrix suppression effects. Therefore, effective derivatization strategies are needed to enable specific, sensitive, and spatially accurate detection.

In this study

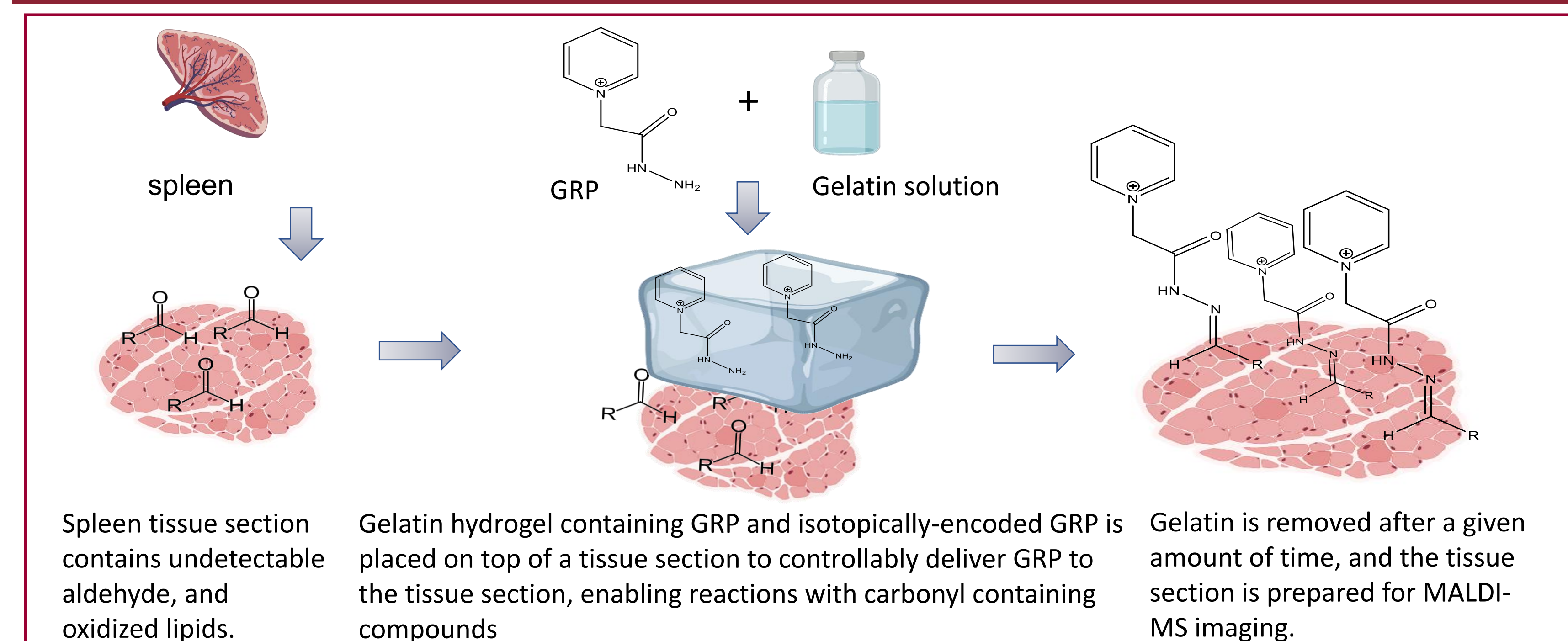
- We explore on-tissue chemical derivatization (OTCD) as a method to improve ionization efficiency and detection sensitivity for these poorly ionizable analytes in MSI experiments.
- We use gelatin hydrogels as a means of uniformly and controllably depositing Girard's P (GRP) reagent and isotopically encoded version of GRP onto biological tissues.
- We detect and image the localization of carbonyl compounds on tissue.

BACKGROUND

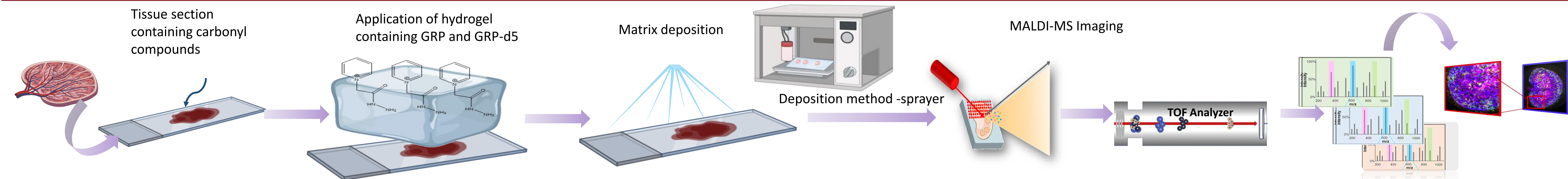
Oxidative stress-related reactions can degrade large biomolecules to small reactive molecules like β -unsaturated aldehydes, while lipid oxidation can create oxidized lipids and aldehydes through β -scission.¹ Due to the low ionization efficiency of these small molecules, the in-situ detection and mass spectrometry imaging (MSI) analysis of compounds with carbonyl moieties, such as oxidized and peroxidized lipids and other endogenous aldehydes, is challenging.¹



EXPERIMENT

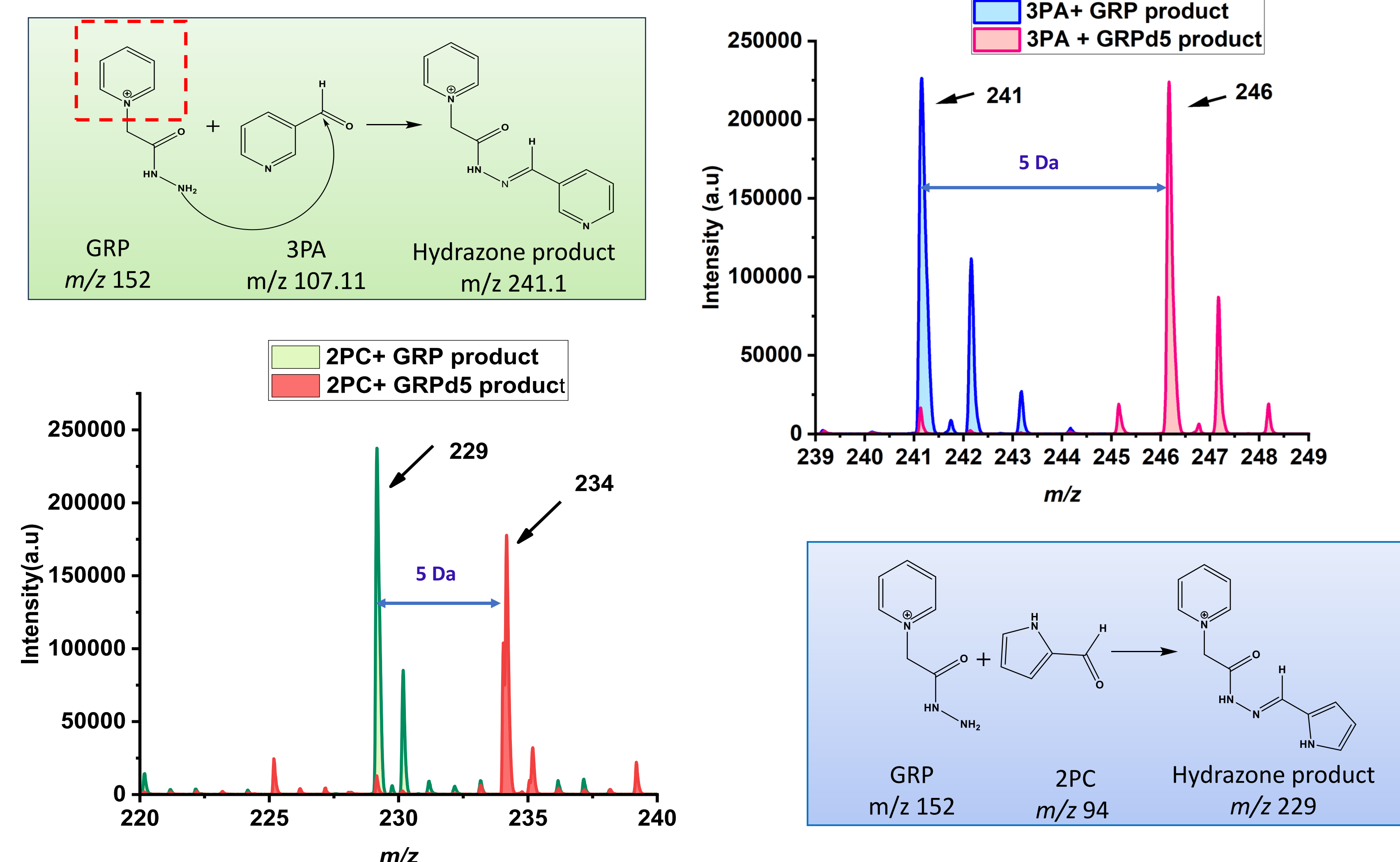


EXPERIMENTAL WORKFLOW

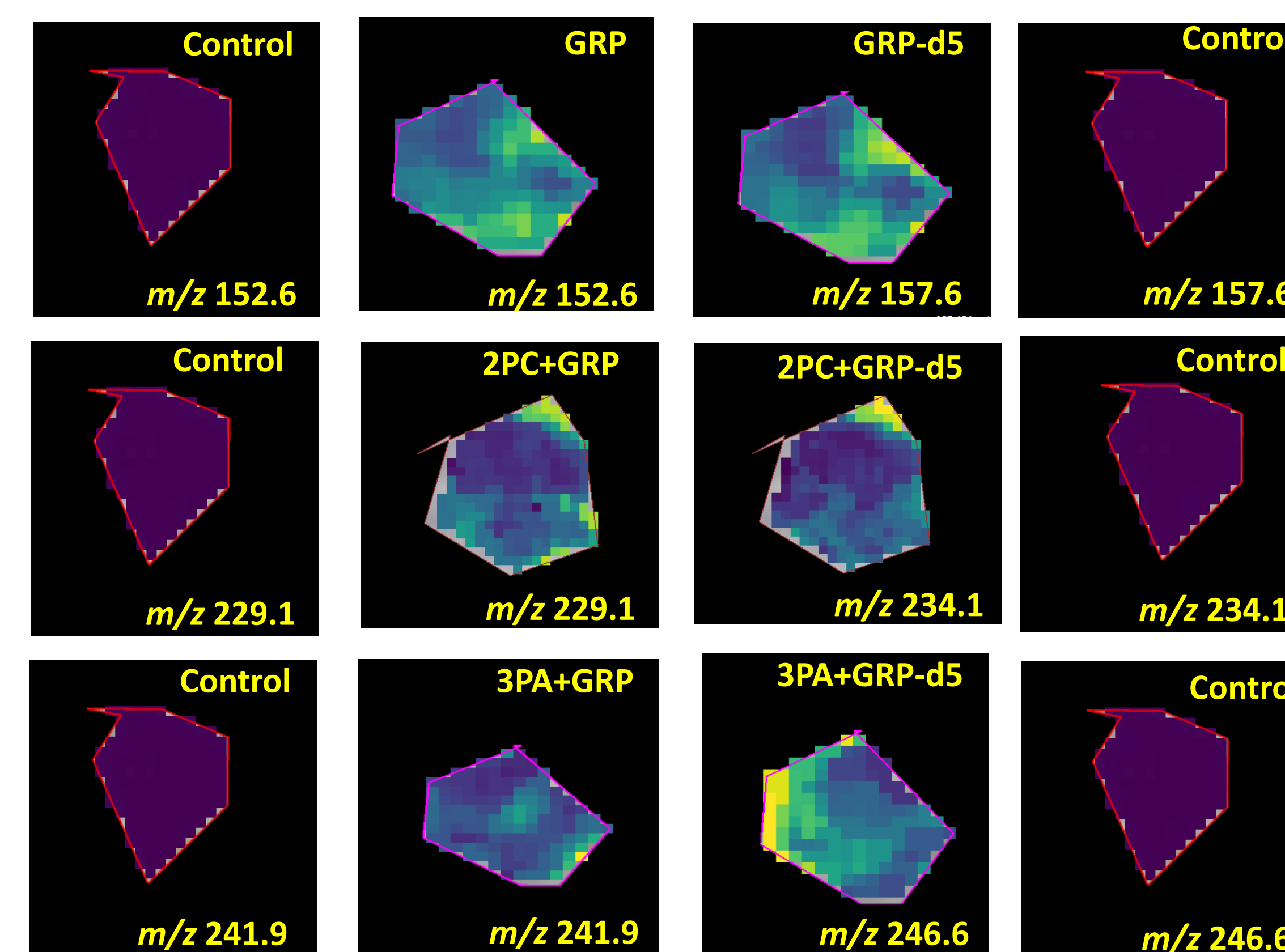


RESULTS & DISCUSSION

Aldehyde standards (i.e. 2-pyrrole carboxaldehyde (2PC) and 3-pyridine carboxaldehyde (3PA)) were spiked into mouse spleen tissue and derivatized using GRP reagent and an isotopically encoded version of GRP (GRP-d5) to identify optimum reaction conditions and assess detection sensitivity.



Spleen tissue section spiked with 3PA and 2PC and derivatized with gelatin hydrogel containing GRP and GRP-d5 of 10 mM concentration.



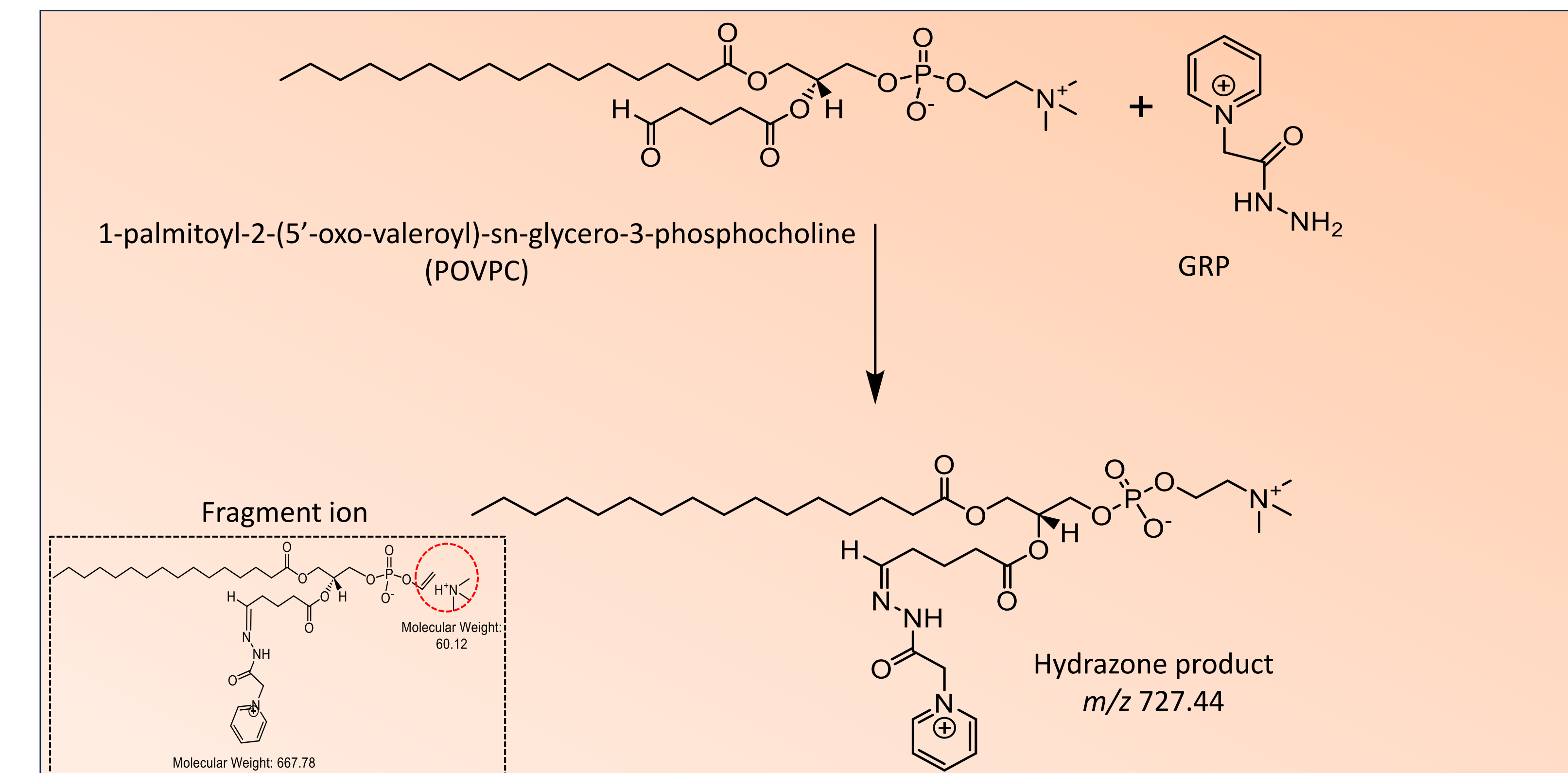
The images of GRP at m/z 152 and GRP-d5 at m/z 157 shows that GRP and isotopic GRP delivered equally on the tissue section

The images at m/z 229 and 234 confirmed successful reaction of 2PC with GRP and GRP-d5, respectively.

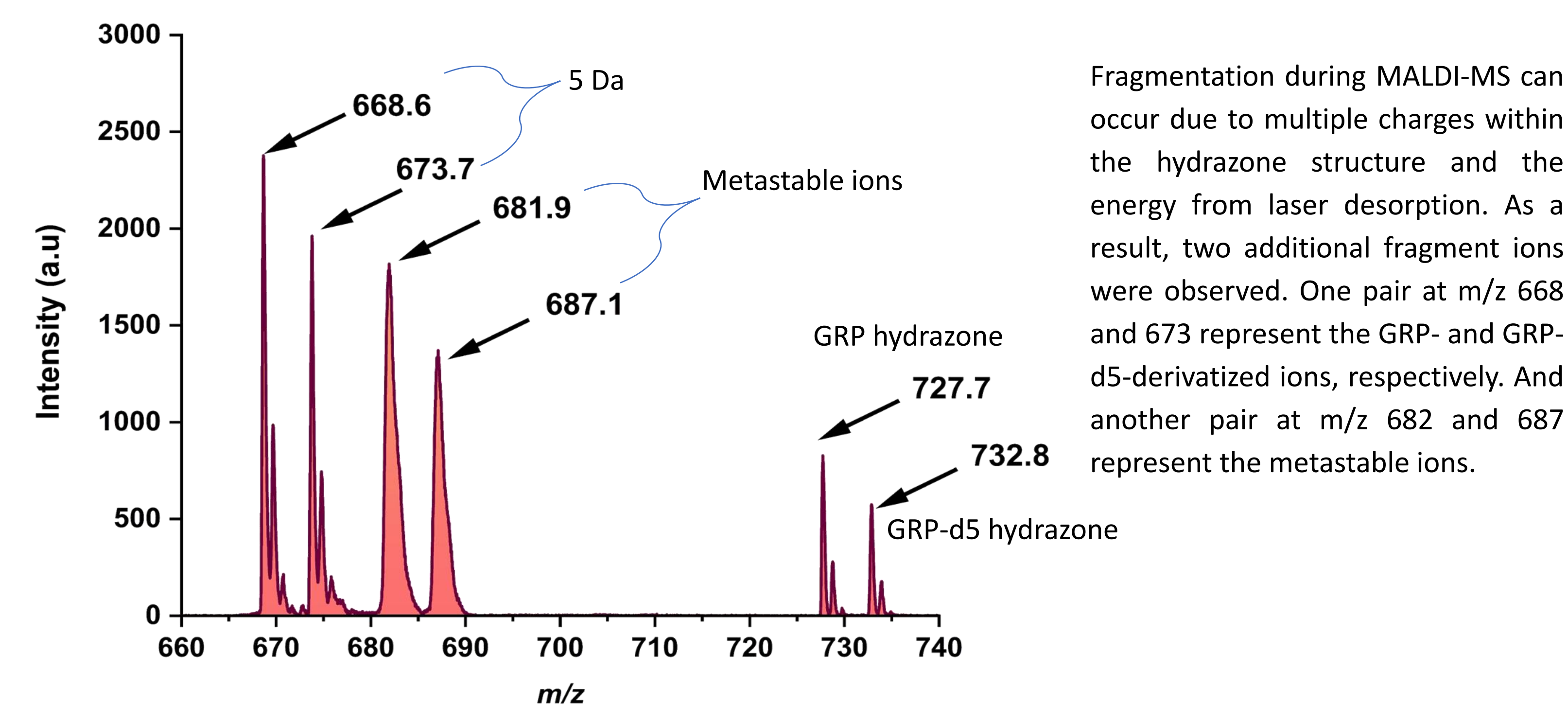
The ions images at m/z 241 and 246 confirmed successful reaction of 3PA with GRP and GRP-d5, respectively. The control tissue sections showed no ion intensity at m/z 241 and 246, confirming that the signals originated from 3PA derivatized with GRP and GRP-d5, rather than from any endogenous tissue metabolite.

Future efforts will aim to achieve a more efficient and uniform deposition of GRP and GRP-d5

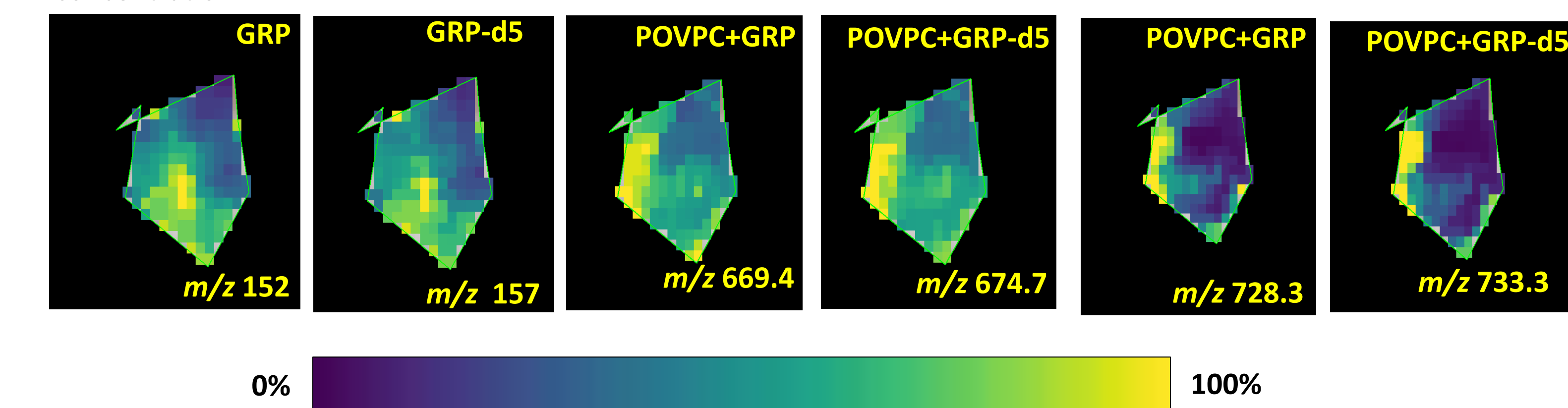
RESULTS & DISCUSSION



Oxidized lipid standard POVPC reacted with GRP (10 mM) and GRP-d5 (10 mM) and produce the corresponding hydrazone products.



Spleen tissue section spiked with POVPC and derivatized with gelatin hydrogel containing GRP and GRP-d5 of 10 mM concentration.



REFERENCES

- 1) Kaya, I. et al. *J. Am. Soc. Mass Spectrom.* **2023**, *34*, 836–846.
- 2) Wang, L. et al. *Anal. Chem.* **2023**, *95*, 1975–1984.
- 3) Zang, Q. et al. *Anal. Chem.* **2021**, *93*, 15373–15380.
- 4) Meng, X. et al. *J. Proteome Res.* **2023**, *22*, 36–46.

ACKNOWLEDGEMENTS



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UMass Chemistry Program
There is no conflict of interest.

CONCLUSIONS & FUTURE DIRECTONS

- Aldehyde standard and oxidized lipid standard successfully react with Girard's reagents and shows the corresponding hydrazone products peaks in tissue.
- *Ex-vivo* imaging experiments with nanomaterial treated mice will be conducted to visualize the localization of metabolites
- This approach holds promise for mapping oxidative stress-related biomarkers in complex biological environments. Ultimately, it could contribute to a deeper understanding of nanomaterial-induced biochemical alterations in tissue.

CONNECT

