

MALDI imaging of animal tissues and fingerprints using the MALDI-8020 benchtop linear MALDI-TOF mass spectrometer

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User Benefits

- ◆ A benchtop linear MALDI-TOF MS is applied to various MS imaging applications showing speed and ease of operation.
- ◆ MS imaging at 30 μm spatial resolution was demonstrated in the rat brain and the fingerprint data.
- ◆ Highly reproducible MS imaging provided by iMLayerTM and MALDI-8020.

Introduction

MS imaging is one of the growing applications in mass spectrometry. While the state-of-art instruments, which have high spatial resolution, high MS resolving power capabilities, have been applied to imaging applications, some demands for miniaturization of instrument and high accessibility are increasing in various scientific/industrial fields, in which a high-performance instrument is not necessary.

In this article, we report the use of a benchtop MALDI-TOF MS for the MS imaging application. The MALDI-8020 and iMLayer, our commercial imaging sample preparation device were able to generate MS images of rat brain and fingerprints at 30 μm spatial resolution with quick and easy operation.

The accessible MS imaging workflow presented in this article, consisting of a benchtop MALDI-TOF MS, matrix deposition methods, and software, could be applicable to various applications.

Method

The MS imaging workflow in this article is shown in Fig.1. The analytical conditions using the MALDI-8020 benchtop linear MALDI-TOF MS are shown in Table 1. All MS imaging experiments were performed at 30 μm spatial resolution in positive ion mode. All data acquisition were performed at 200 Hz repetition rate of MALDI laser. DHB was sublimated onto rat brain and fingerprint by iMLayer. The data was analyzed by IonViewTM.

MS imaging of a rat brain

MS imaging of a rat brain (provided by Dr. Adam McMahon of the Wolfson Molecular Imaging Centre (WMIC) at the University of Manchester) is shown in Fig. 2.

The tissue area analyzed (Fig. 2 A) includes the cerebellum which has a layered structure consisting of different cell populations and regions such as the white and grey matter.

The MS images obtained from using MALDI-8020 (Fig. 2 B-D) revealed lipid biomolecule distributions from the cerebellum and clearly demonstrate the white and grey matter regions.

Table 1 Analytical Conditions of MALDI-8020

Matrix	:	DHB (Sublimation time : 7 min)
Polarity	:	Positive
Spatial resolution (step size)	:	30 μm
Repetition rate of laser	:	200 Hz
Data points	:	84,681 pixel (Rat brain) 23,104 pixel (Fingerprint)

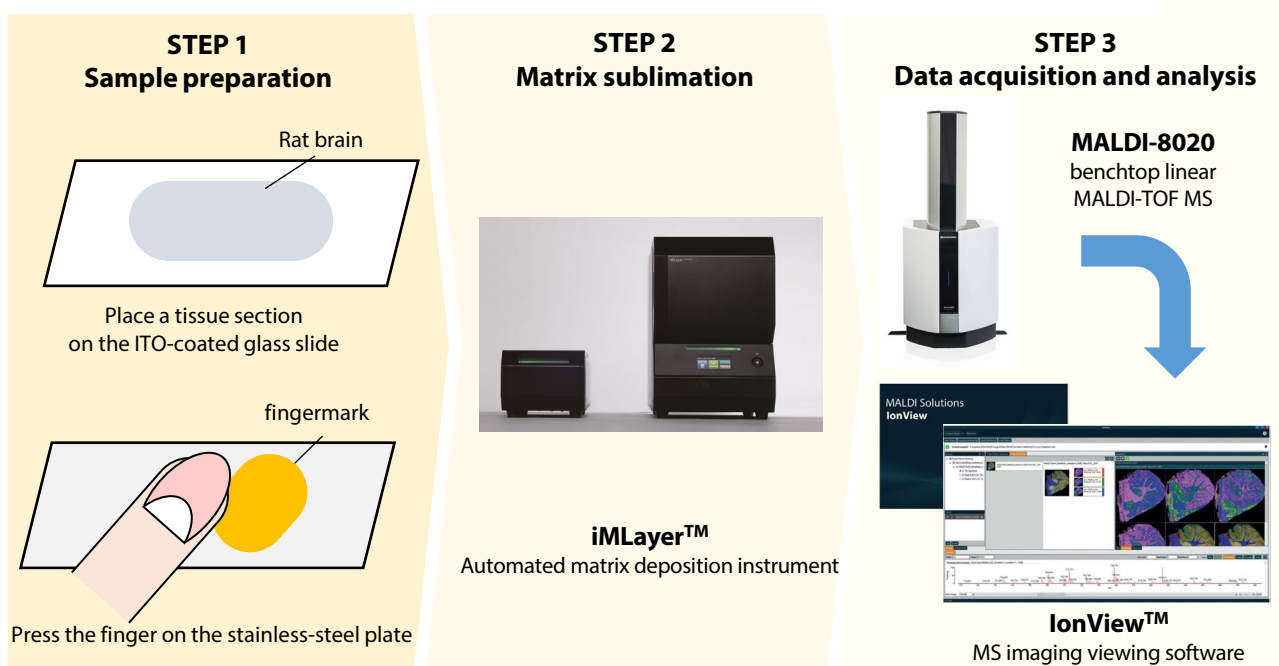


Fig. 1 MS imaging workflow using MALDI-8020

■ MS imaging of a fingerprint

MS imaging of a fingerprint was also performed on a stainless-steel plate. A fingerprint sample was collected according to the workflow shown in Fig. 1., STEP 1.

Once again, the results showed patterns characteristic to the tissue sample with MS images revealing lipid biomolecule distributions synonymous with a fingerprint: in the finger ridge interspaces (m/z 549), in the finger ridge features (m/z 829), and in the sweat glands (m/z 375, 567) (Fig. 3). MS imaging was able to reveal the presence of characteristic substances in areas that cannot be seen in the optical image such as the sweat glands (Fig. 3A). Therefore, in samples where identifying the presence of substances is difficult, interrogating the molecular distribution by MS imaging provides a powerful advantage.

■ Conclusion

In this article, we introduced two applications of MS imaging using MALDI-8020. Fig. 2 and Fig. 3 indicate that sufficient spatial resolution, 30 μm , can be achieved using the MALDI-8020 to conduct MS imaging. The iMLayer offers good reproducibility of sample pretreatment, and the IonView software facilitates analysis of MS image. These products assist all researchers who are not familiar with MS imaging data.

These products and the MALDI-8020 benchtop linear MALDI-TOF MS are expected to provide MS images quickly and easily allowing visualization of molecular distributions to gain new knowledge in various fields.

■ Acknowledgements

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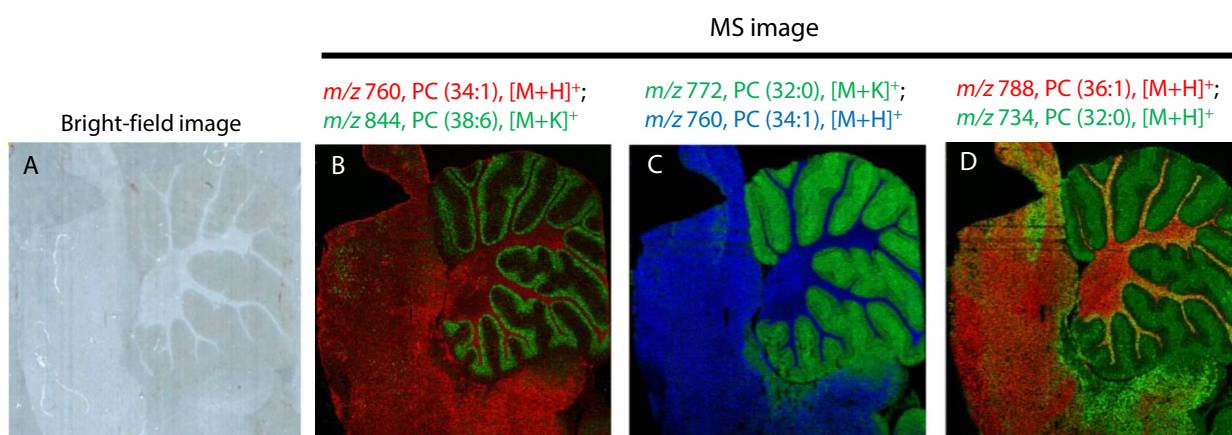


Fig. 2 MS imaging of lipid biomolecules in rat brain at 30 μm spatial resolution

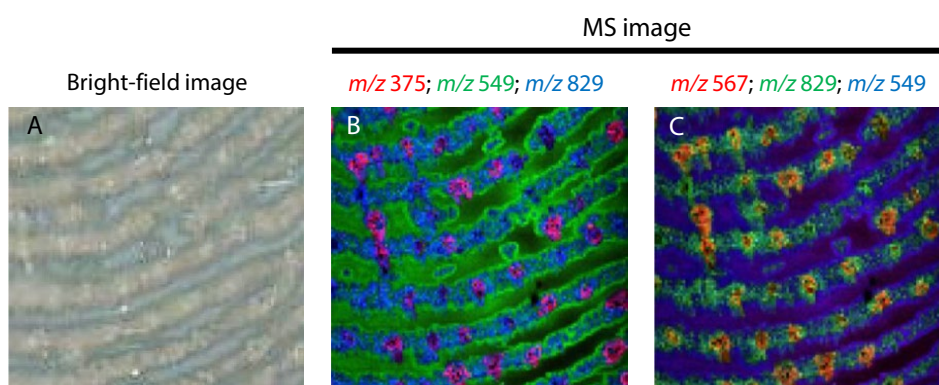


Fig. 3 MS imaging of the fingerprint, including regions of the pores.

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