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Application News

MALDI-TOF Mass Spectrometry Analysis MALDI-8030

Biomarker Analysis for the Clustering of Benignant Nevi from Melanomas using Lipid Phenotype and the MALDI-8030 Dual Polarity Benchtop MALDI-TOF Mass Spectrometer

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User Benefits

- Rapid and easy profiling of lipids in both positive and negative mode on affordable benchtop MALDI-8030.
- MALDI-8030 compatibility with Oncofinder software provides excellent screening of biomarker for melanomas.
- Reduction of the workload in high sample volume routine workflows is possible with the MALDI-8030.

■ Introduction

The MALDI-8030 is the latest benchtop MALDI-TOF mass spectrometer from Shimadzu, building on the affordable, compact and powerful MALDI-8020 with the ability to analyse samples in both positive and negative ion modes. In this note, we demonstrate how the MALDI-8030 can be used to conduct a clustering of benignant nevi from melanomas based on differences in extracted lipid profiles. The results obtained demonstrate the potential of this approach as a rapid biomarker screening tool.

Oncofinder (IMG Pharma Biotech, Spain) is a research use only platform that enables the screening of lipid biomarkers present in tissue or liquid biopsies for the diagnosis, staging and prognosis of melanoma[1]. This panel of lipid biomarkers may be used for the rapid and accurate clustering of benignant nevi from melanomas by studying the lipid fingerprint using mass spectrometry and artificial intelligence (Fig 1).

The combination of the power of mass spectrometry and machine learning also enables the Oncofinder platform to evaluate the lipid biomarkers potential for detection melanoma and prognostic capabilities[1].

In collaboration with IMG Pharma Biotech, we have evaluated the performance of the Oncofinder software as a package with the MALDI-8030 using biomarker data obtained from the analysis of skin biopsy homogenates on MALDI-8030.

■ Measurement Conditions and Samples

Blinded biopsy samples, and replicates, from confirmed nevi and melanoma tissue were homogenized in buffer medium, mixed with MALDI matrices in suitable sample/matrix ratio and deposited on a Shimadzu MALDI target plate. 2-mercaptobenzothiazol (MBT) was used for positive-ion mode and 9-Aminoacridine (9-AA) for negative-ion mode. Spectra were acquired and calibrated both in positive and negative ion modes using a Shimadzu MALDI-8030 dual-polarity benchtop linear MALDI-TOF mass spectrometer. Delayed extraction was set to 885 m/z with an acquisition mass range of 480-1000 m/z in positive-ion mode and 550-1000 m/z in negative-ion mode.

The spectra were analysed and mass list data (ASCII) exported into Oncofinder software. Each spectrum was categorised (nevus or melanoma) by the Oncofinder software in an automated report.

■ Results of Biomarker Analysis

Using biopsy samples, the MALDI-8030 was able to rapidly (~30 sec per sample) generate high quality, reproducible lipid profile spectra in positive and negative ion modes which were shown to be compatible with the Oncofinder software. The lipid fingerprints (see Figs 2 and 3), comprised of >50 lipids, were used to evaluate biomarker performance.

All melanoma samples and replicates were correctly assigned demonstrating good accuracy and reproducibility.

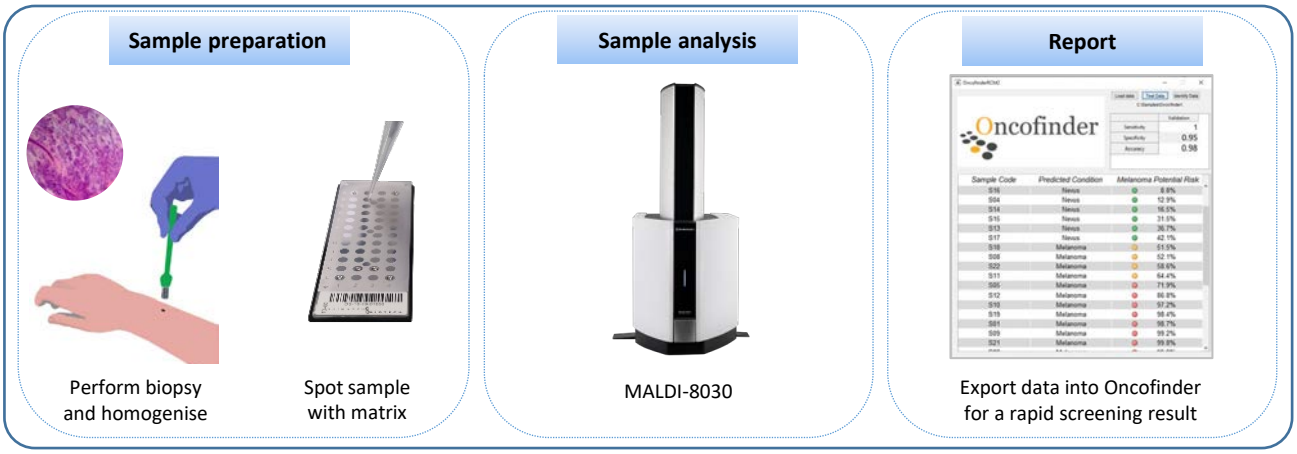

Fig. 1 Workflow for Oncofinder screening

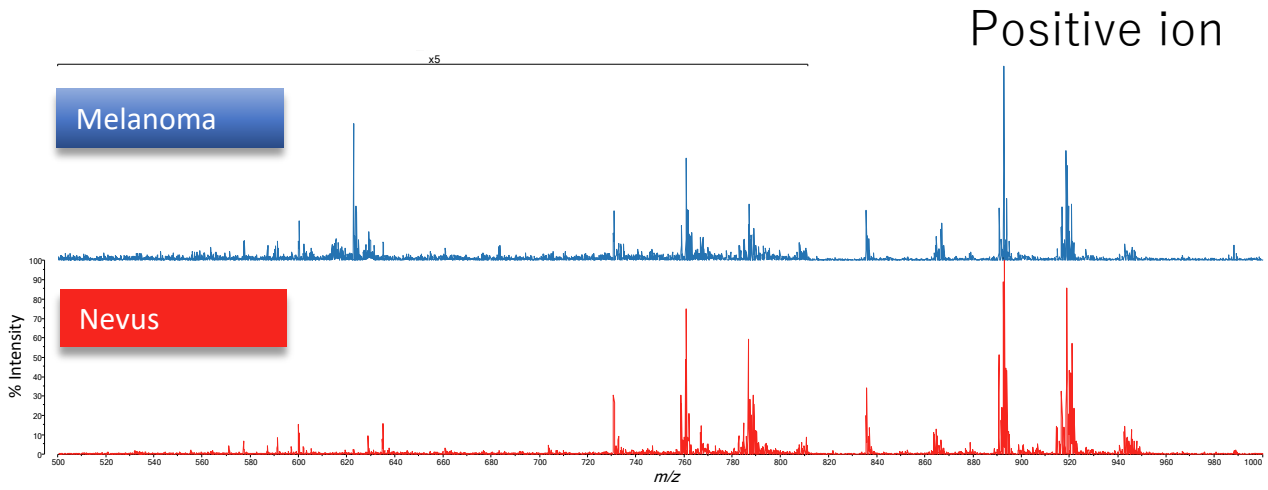

Fig. 2 Spectra acquired in positive ion mode (using MBT matrix) on the MALDI-8030 instrument

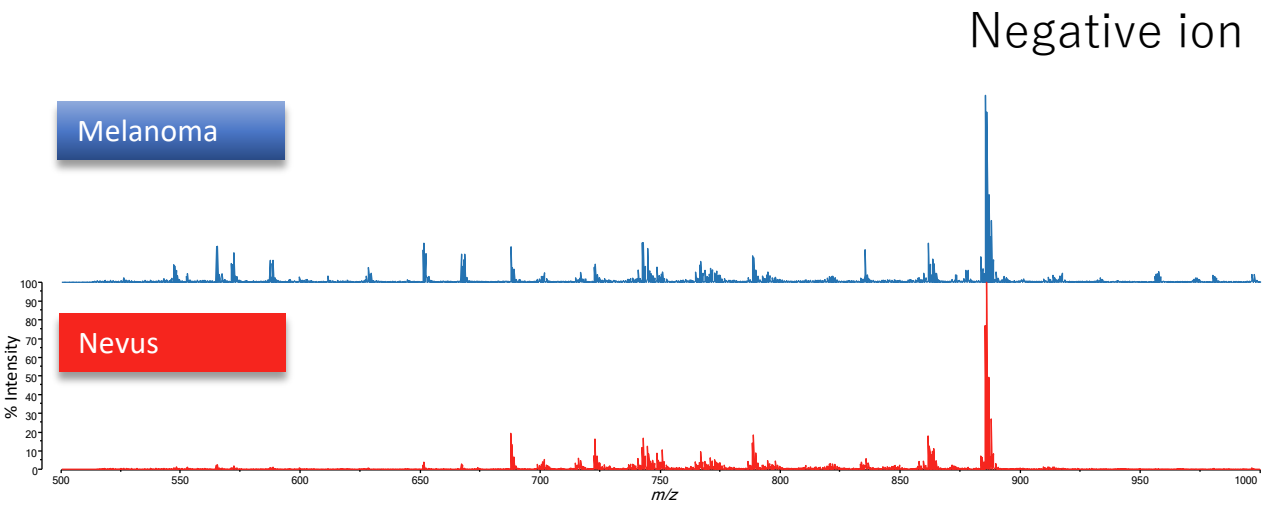

Fig. 3 Spectra acquired in negative ion mode (using 9-AA matrix) on the MALDI-8030 instrument

Two nevus samples were incorrectly classified as melanoma (at 50% probability threshold) but since this is a benign condition, the clinical outcome is not significant and can be confirmed by anatomopathological analysis. The most important aspect of a screening test is that all melanomas are correctly identified.

■ Conclusion

The MALDI-8030 was able to quickly and reproducibly generate high quality, isotopically resolved spectra from lipids in positive and negative ion mode.

This high-quality data was shown to be compatible with the Oncofinder biomarker screening platform for the correct classification of nevus and melanoma biopsy samples.

This quick and simple MALDI-based biomarker approach showed that MALDI-8030 has the potential to provide a cost effective, robust and easy to use alternative to complementary screening methods.

■ References

[1] Microarray and Mass Spectrometry-Based Methodology for Lipid Profiling of Tissues and Cell Cultures. R. Fernández et al. Analytical Chemistry 2019, 91, 24, 15967–15973 DOI:10.1021/acs.analchem.9b04529.

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