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Application News

Imaging Mass Microscope iMScope™ QT

MS Imaging of Natural Toxin Colchicine in Autumn Crocus Bulb Using iMScope QT

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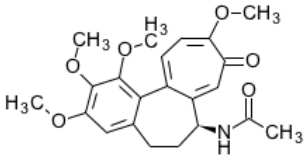
User Benefits

- iMScope QT has a maximum laser repetition rate of 20 kHz for rapid MS image acquisition of large samples.
- Optical images and MS images can be acquired at varying spatial resolution according to the sample.
- The overlay of optical and mass images can be easily observed without any additional procedure.

■ Introduction

Some of the plants around us contain toxic compounds. Some of these poisonous plants look very similar to vegetables, wild plants, and other edible plants. As a result, food poisoning due to accidentally picking and eating toxic plants occurs every year. Among these, food poisoning due to accidental ingestion of the bulb of the autumn crocus is an extremely important food safety issue because of its high fatality rate, although the incident rate is low. Therefore, we analyzed the distribution of colchicine and demecolcin (Fig. 1), which are poisonous compounds contained in the autumn crocus bulb, by MS imaging.

colchicine



demecolcin

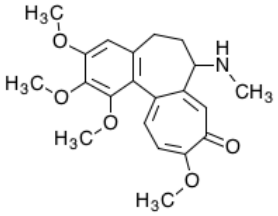


Fig. 1 Structural formula of colchicine (top) and demecolcin (bottom)

■ Preparation of frozen sections of autumn crocus bulb

Autumn crocus bulb was cut in half lengthwise (Fig. 2), fresh-frozen, thinly sliced horizontally to a thickness of 30 µm using a cryostat, and fixed to ITO-coated glass slides.

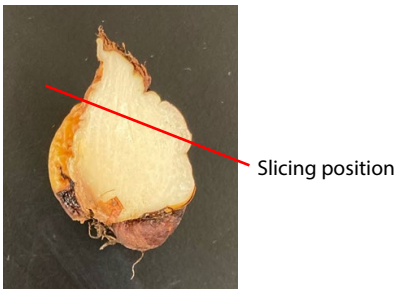


Fig. 2 Autumn crocus bulb was cut in half lengthwise

■ MS Imaging Analysis Conditions

CHCA was used as the matrix, which is an ionization aid. For matrix application, we used the iMLayer™ (Fig. 3), an automated matrix deposition system capable of depositing matrix uniformly and reproducibly. For mass spectrometry, we used the iMScope QT imaging mass microscope (Fig. 4), which can seamlessly perform everything from microscopic observation of samples to mass spectrometry. The analytical conditions for MS imaging are shown in Table 1.

Fig. 3 iMLayer™

Fig. 4 iMScope™ QT

Table 1 Analysis Conditions for MS imaging

Matrix Coating		
Instrument Name	:	iMLayer
Matrix Used	:	CHCA
Coating Method	:	Deposition with 0.7 µm Thickness
Mass Spectrometry		
Instrument Name	:	iMScope QT
Spatial Resolution (Pitch)	:	10 / 25 µm
Polarity	:	Positive
Mass Range	:	*m/z* 370 - 405
Laser Irradiation Number	:	50 [shots]
Laser Repetition Frequency	:	20 / 1 [kHz]
Laser Diameter Setting	:	1 / 2
Laser Intensity	:	50.0 / 60.0

■ MS imaging of whole sections

First, MS imaging of the whole section was performed. With the measurement pitch set to 25 µm, the analysis area was 378,594 pixels, a large number of pixels due to the size of the section. However, by setting the laser repetition frequency to 20 kHz, a good MS image was obtained in less than 4 hours of analysis time (Fig. 5). The results showed that colchicine was distributed predominantly in the periphery of the bulb. On the other hand, demecolcin was found to be almost uniformly distributed throughout the bulb.

■ MS imaging of area observed under microscope

MS imaging of the area observed at 10x objective lens was then performed. The analysis was performed with the measurement pitch set at 10 µm. As a result, it was confirmed that colchicine was distributed more in the periphery of the scales and demecolcin was uniformly distributed as in the MS image of the entire section (Fig. 6).

■ Conclusion

The distribution of the toxic compounds colchicine and demecolcin in autumn crocus bulb were analyzed by MS imaging. It was found that colchicine was more abundant in the periphery of the bulb, while demecolcin was uniformly distributed. Distribution analysis of toxic compounds in plants using MS imaging is useful for elucidating the toxic sites of the plants. The iMScope QT has a laser repetition rate of up to 20 kHz, enabling rapid MS imaging of large samples. Analysis of an entire section like this requires an enormous number of pixels. iMScope QT can produce an informative and high quality MS image in a few hours. Thus, for MS imaging of whole sections, the iMScope QT with its fast analysis capability is a useful tool.

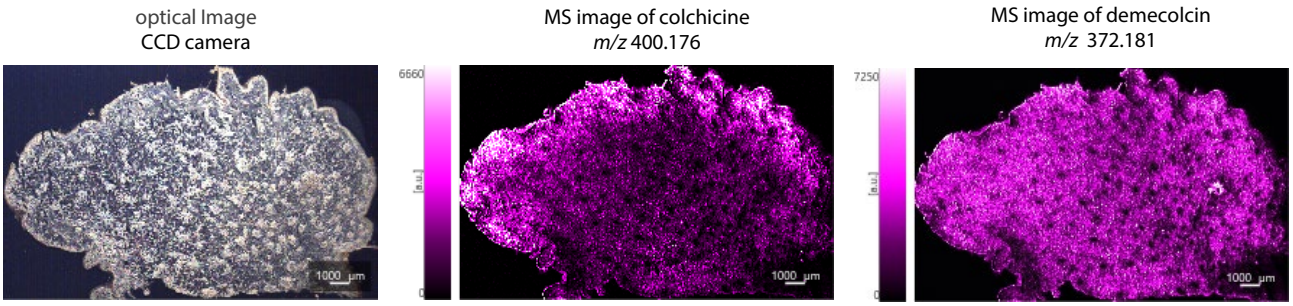


Fig. 5 MS image of colchicine and demecolcin in autumn crocus bulb at 25 µm spatial resolution

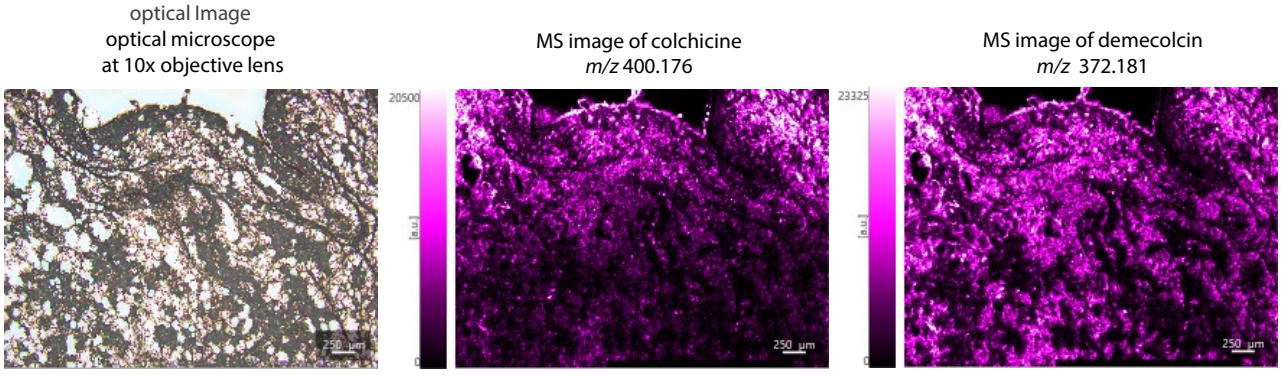


Fig. 6 MS image of colchicine and demecolcin in autumn crocus bulb at 10 µm spatial resolution

01-00610-EN First Edition: Sep. 2024

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