



Monitoring of brown rot caused by *Monilia fructigena* on plums with the aquaphotomics approach

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INTRODUCTION

- Plums are particularly sensitive and perishable fruits that ripen quickly after harvest, resulting in a short postharvest lifespan.
- Monilia* species causing brown rot during fruit cultivation, harvest, or storage can result in losses of up to 80% under favorable conditions for the fungus.
- Due to change in the ambient conditions or infection on the fruit result in invisible alterations at first but can be discovered by examining the patterns given by non-invasive near-infrared spectroscopy.
- The “water mirror” approach of aquaphotomics has proven to be suitable to map and determine the physiological state of horticultural products with a high water content.

AIMS

The research focused on tracking changes in plums during storage.

The study aimed to apply NIRS and aquaphotomics:

- for monitoring quality change of fruits stored under different conditions,
- early detection of *Monilia fructigena* infection.



Figure 2. Spectra acquisition with a hand-held NIR spectrometer

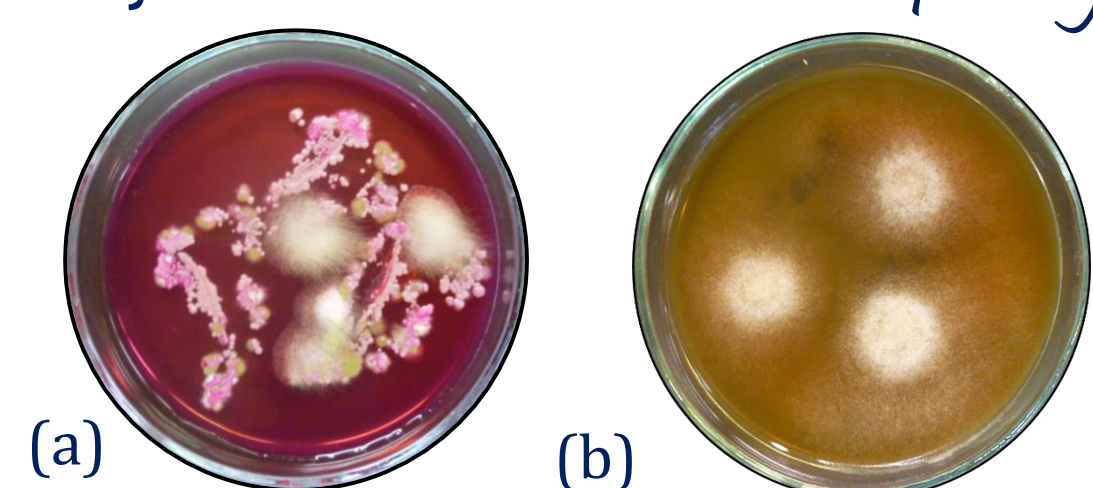


Figure 1. Plum surface microflora during *Monilia* isolation (a); *M. fructigena* culture (b)

MATERIALS AND METHODS

Fruit samples

- Plums were inoculated with *Monilia fructigena* fungal mycelium (Fig. 1) and stored at refrigerated ($\sim 3^\circ\text{C}$) or room temperature ($\sim 22^\circ\text{C}$) for 8 days:
 - Control – the surface of the fruits was disinfected
 - Injury – inoculation after 1 cm cut on the fruit surface with a sterile knife
 - Intact – inoculation on intact surface
- Five parallel sample preparations were performed per sample group.

Near-infrared spectroscopic (NIRS) measurements

- Spectrum acquisition with NIR-S-G1 hand-held reflectance spectrometer
- Spectral data collection in the wavelength range of 900-1700 nm
- Measurements along the vertical axis of the fruits at five measurement points on which 3 consecutive scans were recorded twice a day (Fig. 2).

Data analysis

- The pretreatment of the NIR spectra was optimized in the wavelength range of 1300-1600 nm.
- Principal component analysis (PCA) – pattern mapping and outlier detection
- Soft independent modeling of class analogies (SIMCA) – sample discrimination and classification by storage time and inoculation modes
- Aquagrams – visualization of spectral pattern trends

RESULTS AND DISCUSSION

Visible signs of *Monilia* infection were observed after two days only on plums with injured surfaces and stored at room temperature.

The results showed high variability, therefore the constructed models had to be optimized in each case using different spectrum pretreatment methods.

PCA confirmed that the results were considerably influenced by the location of the spectrum acquisition on the fruit surface.

Soft independent modeling of class analogies

Interclass distances indicated demonstrably large differences between infected plums stored under different conditions.

As storage time increased, fruits stored at room temperature showed a crescent interclass distance compared to refrigerated samples.

Plums infected via injury had a larger interclass distance compared to control and intact samples, although there was no incontrovertible distinguishability.

The following wavelengths were relevant for discrimination by storage duration or mode of infection: 1393, 1403, 1415, 1446, 1484, 1539, 1571 nm.

Aquagrams

The spectral patterns of plums showed a dynamic change over the storage time (Figure 3).

The absorbance evolution of injured plums stored in the refrigerator and at room temperature showed the opposite trend in the 1365-1384 nm wavelength range.

The absorption gradually decreased in the range of 1411-1489 nm during storage.

The plums initially showed markedly low absorbance around 1512 nm.

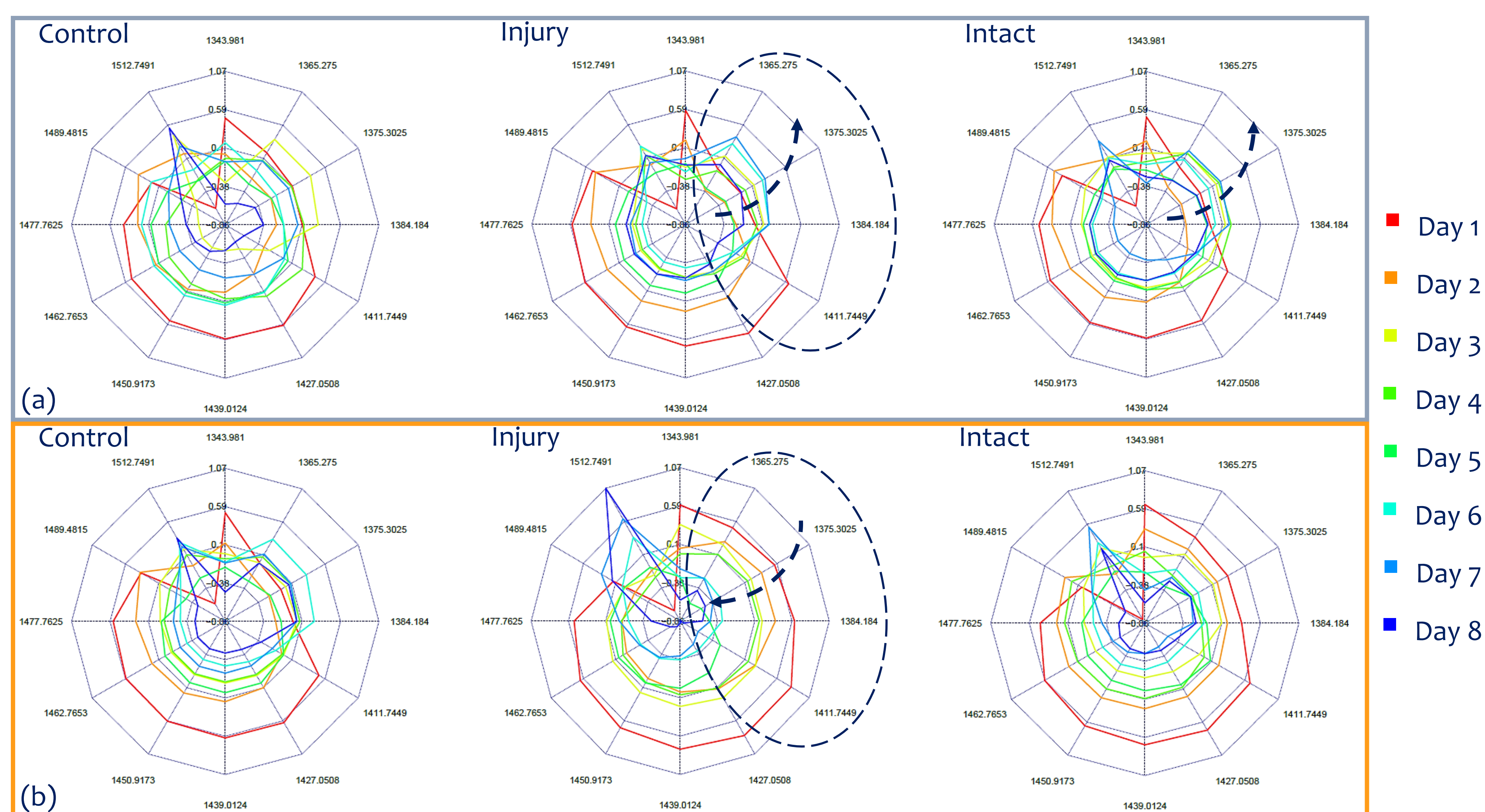


Figure 3. Aquagrams of plums infected with *Monilia fructigena* in different ways and stored at refrigerated (a) or room temperature (b)

CONCLUSIONS

There were detectable differences in plums infected with *Monilia fructigena* in different ways during controlled storage. The most striking differences were for fruit stored at room temperature and infected through injury. The approach used proved to be fruitful for predicting the progression of the infection, in any way it would be worthwhile to conduct further experiments with larger sample size by reason of the natural variability of the fruits.

ACKNOWLEDGEMENT

The research was supported by the Doctoral School of Food Science SZIU, by the ÚNKP-20-3-II-SZIE-25 (FV) ÚNKP-20-3-II-SZIE-12 (ZB) and New National Excellence program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund, and by project No. GINOP-2.2.1-18-2020-00025 by European Union and co-financed by the European Regional Development Fund and the Hungarian Government.