



The 4th Aquaphotomics International Conference

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

Flora Vitalis ^{1,*}, Juan Pablo Aguinaga Bósquez ¹, Balkis Aouadi ¹, Zsanett Bodor ¹, John-Lewis Zinia Zaukuu ¹, Zoltan Gillay ¹, Zoltan Kovacs ¹

¹ Department of Measurements and Process Control, Institute of Food Science and Technology, Hungarian University of Agriculture and Life Sciences, 1118 Budapest, Hungary;

* Presenting author and Correspondence: vitalis.flora@hallgato.uni-szie.hu

Keywords: plum, storage, brown rot, aquaphotomics,

Introduction

Fruits and fruit products play a very important role in the human nutrition, they are very good sources of compounds with positive physiological effect. Plums are one of the most important stone fruits, they can be found on the market shelves, both fresh or processed. Plums are particularly sensitive and perishable fruits that ripen quickly after harvest, resulting in a short postharvest lifespan. The shelf life of these fruits is about 2-6 weeks [1]. The rapidness and quality of complex changes during ripening, harvesting, and storage are highly dependent on environmental influences such as temperature, humidity, microbiological contamination, and treatment. It is not uncommon for these changes to adversely affect the physicochemical and organoleptic properties of fruits. *Monilinia* species causing brown rot on fruits during fruit cultivation, harvesting, or storage can result in losses of up to 80% under favorable environmental conditions for the fungus [2]. Rapid and non-invasive near-infrared (NIR) spectroscopy-based methods are becoming widespread in the determination of physiological condition and certain quality traits of fruits in addition to empirical and/or laboratory-based, often destructive and costly techniques. Change in ambient conditions or infection on the fruit result in alterations that are initially invisible to the naked eye, but can be identified from the spectral patterns [3]. Due to the naturally high water content of fruits, thusly plums, the “water mirror” approach of aquaphotomics is presumably suitable for mapping the differences that occur [4, 5]. Our research focused on monitoring changes in plums during storage. The study aimed to apply NIRS and aquaphotomics for monitoring of quality change of fruits stored under different conditions and early detection of *Monilia fructigena* infection.

Materials and Methods

The plums were divided into two groups for refrigerated and room temperature storage, and their surface was disinfected. About 1 cm of cut was applied to the surface of one-third of the plums with a sterile knife and was infected with *Monilia fructigena* fungal mycelium. The second third of the plums were infected on the fruit surface without injury. The remaining third was left intact, these formed the control group. Five parallel sample preparations were performed per sample group. The resulting 30 plum samples (i. e. $2 \times 3 \times 5$) were subjected to NIR-based analysis. The spectral data were collected with a NIR-S-G1 (InnoSpectra Co., Hsinchu, Taiwan) hand-held reflectance spectrometer in the wavelength range of 900-1700 nm. Spectra were recorded along the vertical axis of the fruits (from stalk to apex) at five measurement points. Three consecutive scans were recorded at each measurement point. The measurements were performed twice daily for eight days. A total of 450 sample spectra (i. e. $30 \times 5 \times 3$) were collected per measurement occasion. The data were evaluated in the wavelength range of 1300-1600 nm after combined spectral pretreatments. Exploratory principal component analysis (PCA) was used to map the patterns and to identify outliers in the data. Soft independent modeling of class analogies (SIMCA) was applied as supervised methods to discriminate and classify samples. Aquagrams were constructed to illustrate the trends hidden in the data.

Results

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. It was confirmed by PCA that the location of the spectrum acquisition on the plums was also influential, so it was worth examining them separately. In this way, it was possible to determine which measuring points on the surface of the fruits were the most suitable to discriminate storage time or sample groups. The SIMCA interclass distances indicated demonstrably large differences between infected plums stored under different conditions. Of all sample groups, the largest interclass distances were detected in the results of injured plums. However, there was no incontrovertible distinguishability within sample groups. The spectral patterns of plums showed a dynamic change over the storage time. The similarity in the patterns was that the plums initially showed markedly low absorbance around 1512 nm, which can be attributed to the absorption band of strongly bound water molecules. In the range of 1411 to 1489 nm, the absorbance gradually decreased. The absorbance of plums stored under refrigerated conditions increased between 1365 and 1384 nm (Fig. 1a), while samples stored at room temperature behaved oppositely (Fig. 1b).

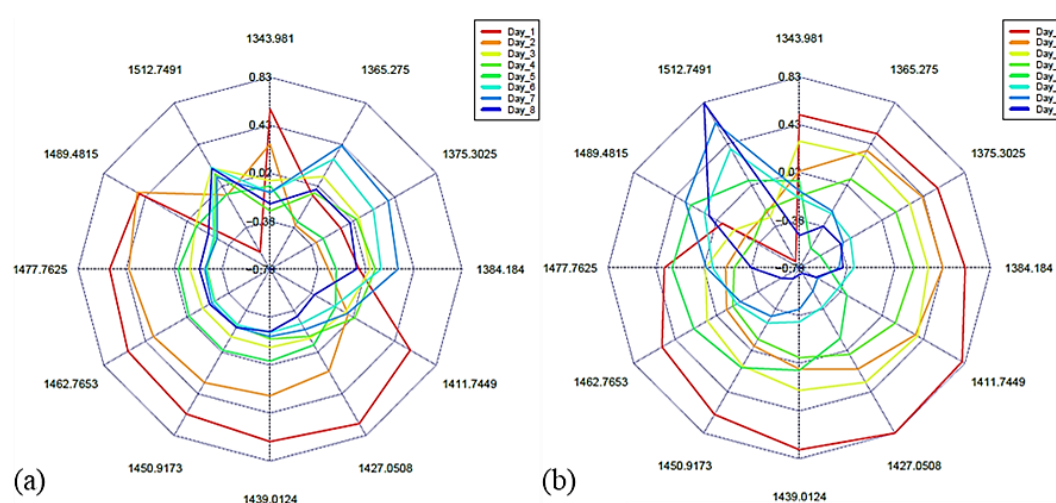


Figure 1. Aquagrams of plums infected with *Monilia* through injury stored at refrigerated (a) and room temperature (b)

Conclusions

In the present study, the alterations caused by *Monilia fructigena* fungal infection were monitored in plums. The research results are of both economic and scientific significance, as postharvest technologies and *Monilia* infection can cause large losses and there are few scientific sources on the use of rapid analytical methods in this area, especially for plums. There were detectable changes in plums during storage. Due to the natural variability of the fruits, it would be worthwhile to conduct further experiments with larger sample size.

References

- Manganaris GA, Crisosto CH (2020) Stone fruits: Peaches, nectarines, plums, apricots. In: Controlled and Modified Atmospheres for Fresh and Fresh-Cut Produce. Elsevier, pp 311–322
- Aiello D, Restuccia C, Stefani E, et al (2019) Postharvest biocontrol ability of *Pseudomonas synxantha* against *Monilinia fructicola* and *Monilinia fructigena* on stone fruit. *Postharvest Biol Technol* 149:83–89
- Jinendra B, Tamaki K, Kuroki S, et al (2010) Near infrared spectroscopy and aquaphotomics: Novel approach for rapid in vivo diagnosis of virus infected soybean. *Biochem Biophys Res Commun* 397:685–690
- Tsenkova R (2010) Aquaphotomics: Water in the biological and aqueous world scrutinised with invisible light. *Spectrosc Eur* 22:6
- Kaur H (2020) Investigating aquaphotomics for fruit quality assessment. The University of Waikato