APPLICATION OF VISIBLE/NEAR INFRARED SPECTROSCOPY TO ASSESS THE GRAPE INFECTION AT THE WINERY

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Scope

At the checkpoint station the wineries need an objective method for the grape infection assessment. For this purpose the Department of Agricultural and Environmental Sciences (DiSAA) of the Università degli Studi di Milano has investigated the applicability of an optical system performing spectroscopic measurements in the visible near infrared (vis/NIR) region to estimate in a rapid and non destructive way, the phytosanitary status of bunches after the consignment to the winery.

The spectroscopic analysis

The vis/NIR analysis allows to obtain information on the structural composition of sample through the interaction with the electromagnetic radiation (light) which induces a variation of vibrational energy in molecules (Figure 1).

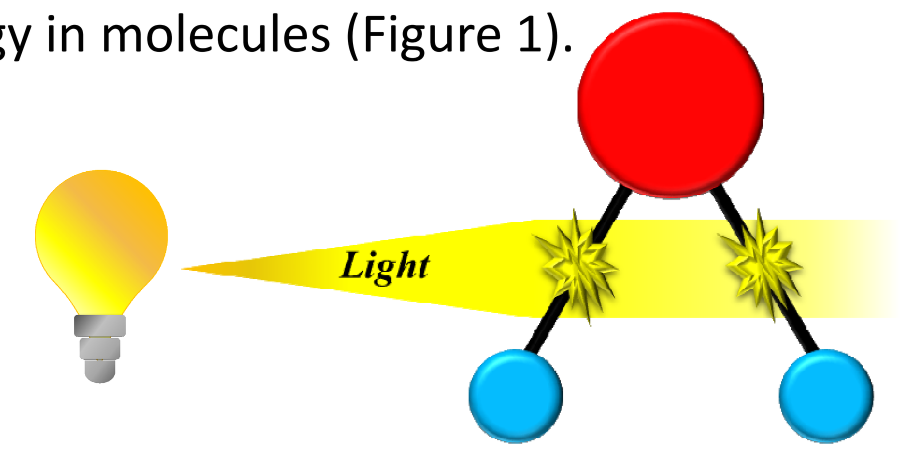

Fig. 1. Interaction of the electromagnetic waves (light) with water molecule (H_2O).

The spectral acquisitions were obtained from grape samples using the Corona Process system (Zeiss, Germania) (Figure 3).

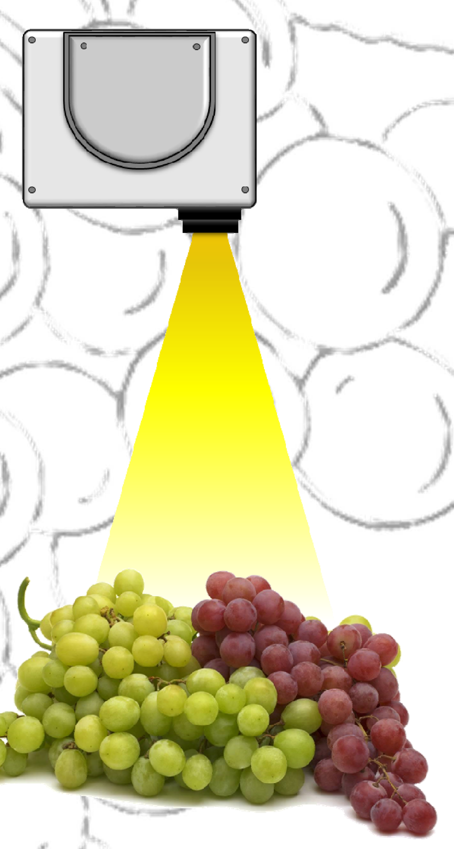

Fig. 3. Grapes bunches spectra acquisition method.

Sampling

Sampling was done considering healthy grapes and naturally infected bunches by Botrytis cinerea, powdery mildew and sour rot (Figure 2). For the experimentation were used 2559 red and white grapes bunches in healthy and infected conditions.

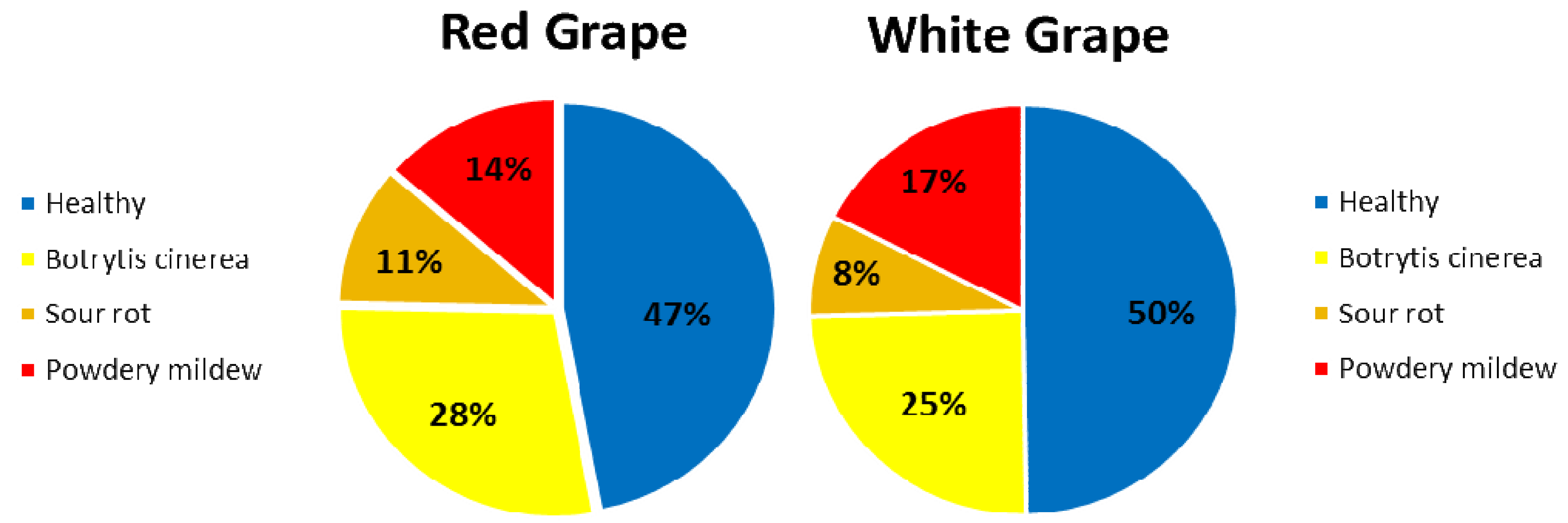

Fig. 2. Percentage of red and white grapes healthy and infected by Botrytis cinerea, powdery mildew and sour rot.

Qualitative analysis

Figure 4 shows the average spectra acquired from healthy and infected (by Botrytis cinerea, powdery mildew and sour rot) grapes (red 4a, white 4b), in order to draw attention to the spectral differences. **In the NIR region (950-1600 nm), it's possible to highlight a variation of the reflection of about 10%**. Considering these differences, it is possible to train the instrument for a recognition of only healthy grape spectra.

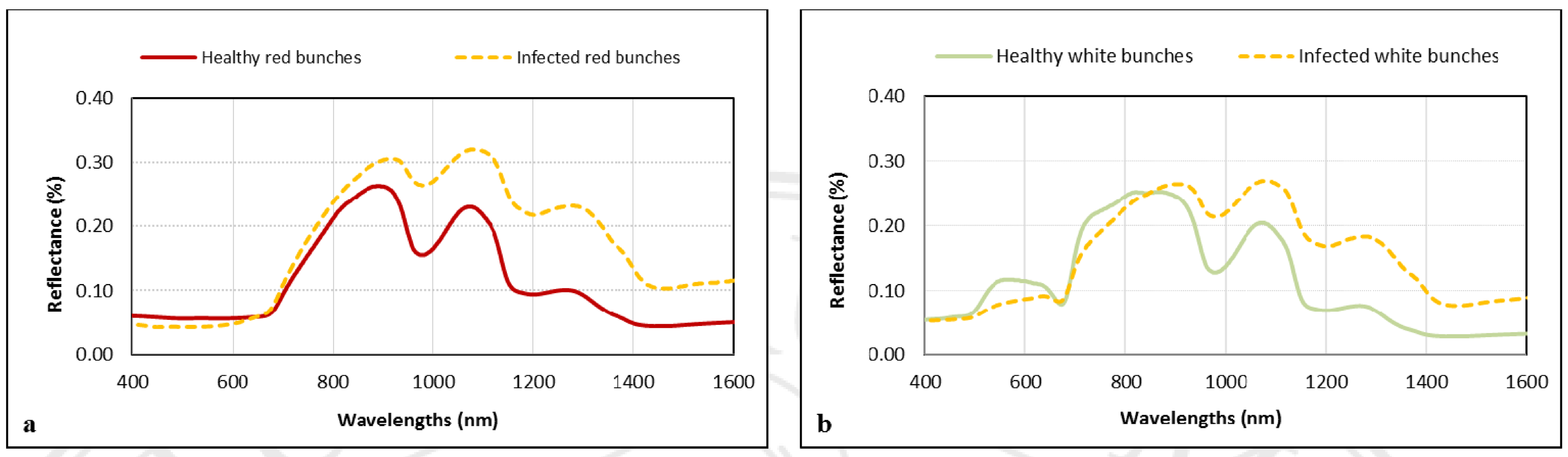

Fig. 4. Average spectra of healthy and infected grapes of red (a) and white cultivars (b).

Classification analysis

The spectral data were employed for the elaboration of **PLS-DA classification models**. The spectral data was used to set up models to classify the samples as healthy or infected.

Table 1 shows the results from the different samples datasets. For each PLS-DA model is reported the coefficient of determination R^2 and the amount of correctly (positive predictive value, PPV) and non-correctly (negative predictive value, NPV) classified samples.

These results determine a satisfactory performance level in the vis/NIR application to check the grapes phytosanitary status.

Table 1. PLS-DA classification models for red and white grape bunches.

Samples	N° of samples	Calibration			Cross-validation		
		R^2_{cal}	PPV_{cal}	NPV_{cal}	R^2_{cval}	PPV_{cval}	NPV_{cval}
Red grape	1375	0.62	1238	137	0.61	1235	140
White grape	1184	0.67	1085	99	0.66	1079	105
Total bunches	2559	0.63	2308	251	0.62	2301	258

Conclusions

The Results are promising but further tests are desirable for a future real scale application.

Regarding the scale-up of the innovation, the optical system could be positioned on a conveyor belt between the grape reception area and the grape discharge hopper. With this solution, the measurement of the whole mass of grapes (transported in a thin layer on the belt) could be performed, resulting in an assessment of the infection degree of the total grape amount. Finally, **the automation of the grape assessment should be considered as a practical solution to solve the disagreements problems between members and wineries, evaluating in an objective way the grape phytosanitary status.**

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