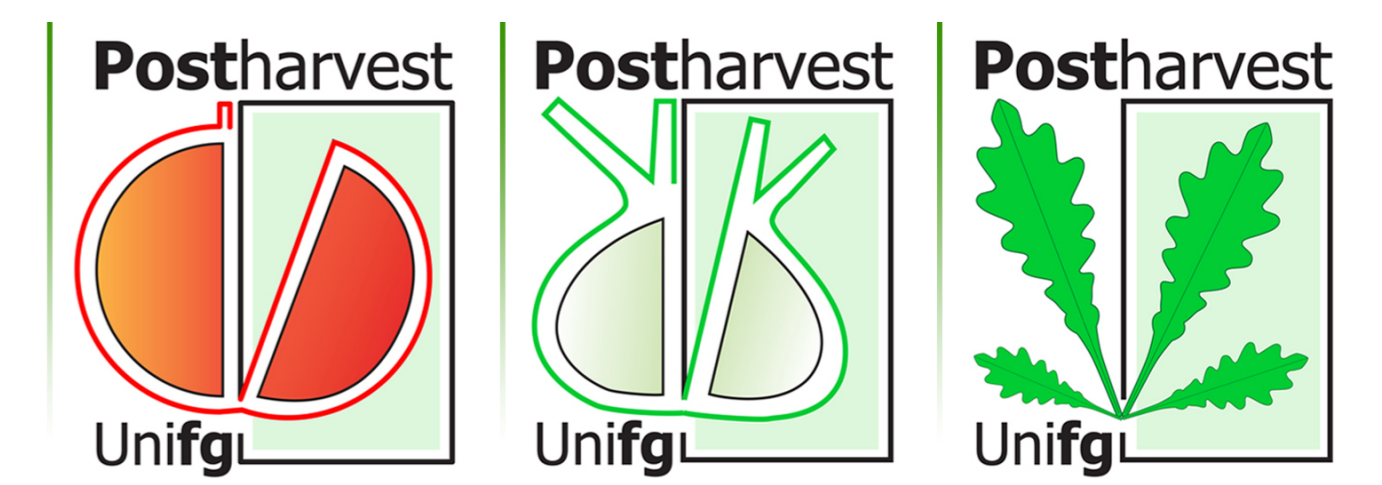


# Potential Of Hyperspectral Imaging To Predict Quality And Shelf-Life Of Fresh Rocket Leaves To Be Used For Fresh-Cut Processing

Mudassir Chaudhry, Giancarlo Colelli, Maria Luisa Amodio

Dept. Science Agriculture, Food & Environment  
University of Foggia, Via Napoli 25, 71122 Foggia, Italy  
(marialuisa.amodio@unifg.it)



Wild rocket (*Diplotaxis tenuifolia*) is one of the most popular leafy vegetable in Europe, often eaten raw, alone or in mixed salads. It is normally sold in bags, already washed, and ready to be eaten. Minimally processed products deteriorate faster than the correspondent intact produce and the initial quality of raw material is of crucial importance. Moreover due to the high price that consumers are willing to pay for these produce, high quality standard is expected. Nowadays quality of the incoming products is subjectively evaluated by the operators applying rating scales (from 3 to 5 points) for the main quality attributes: color, defects, decay, and wilting. Therefore many companies are looking for possible alternative system for the evaluation of the quality in a faster, non destructive, and more objective ways, possibly including some information on internal quality.

## Objective:

This preliminary study was conducted for:

- Assessment of the potentiality of HSIs for shelf life estimation of rocket leaves
- Estimation of the extent of quality degradation in packed rocket leaves based on visual scores

**Experiment:** Rockets leaves were washed and dried in a processing company and then packaged in the laboratory of the University of Foggia in PP bags, simulating commercial conditions (passive modified atmosphere) and stored at 5° C. Three different experiments were conducted packaging 10 bags for each sampling time, resulting in 180 samples (7 samplings for exp1 and 2, and 4 for exp 3). At each sampling time, after opening the bags, 10 leaves were scanned in one image using a Hyperspectral scanner (version 1.4, DV srl, Padova, Italy) in the VIS-NIR range (from 400 to 1000 nm) (spectral resolution of 5 nm and spatial resolution 315dpi) and a sample was also evaluated for appearance and off-odor using a 5 point scale with 3=limit of marketability.

Images were pre-processed, to extract mean spectra and eliminate outliers. PLS calibration model was developed based on 30 initial spectra to estimate the potential shelf-life (number of days to reach score 3 for visual appearance and off odors). Different pre-treatments were applied to the spectra.

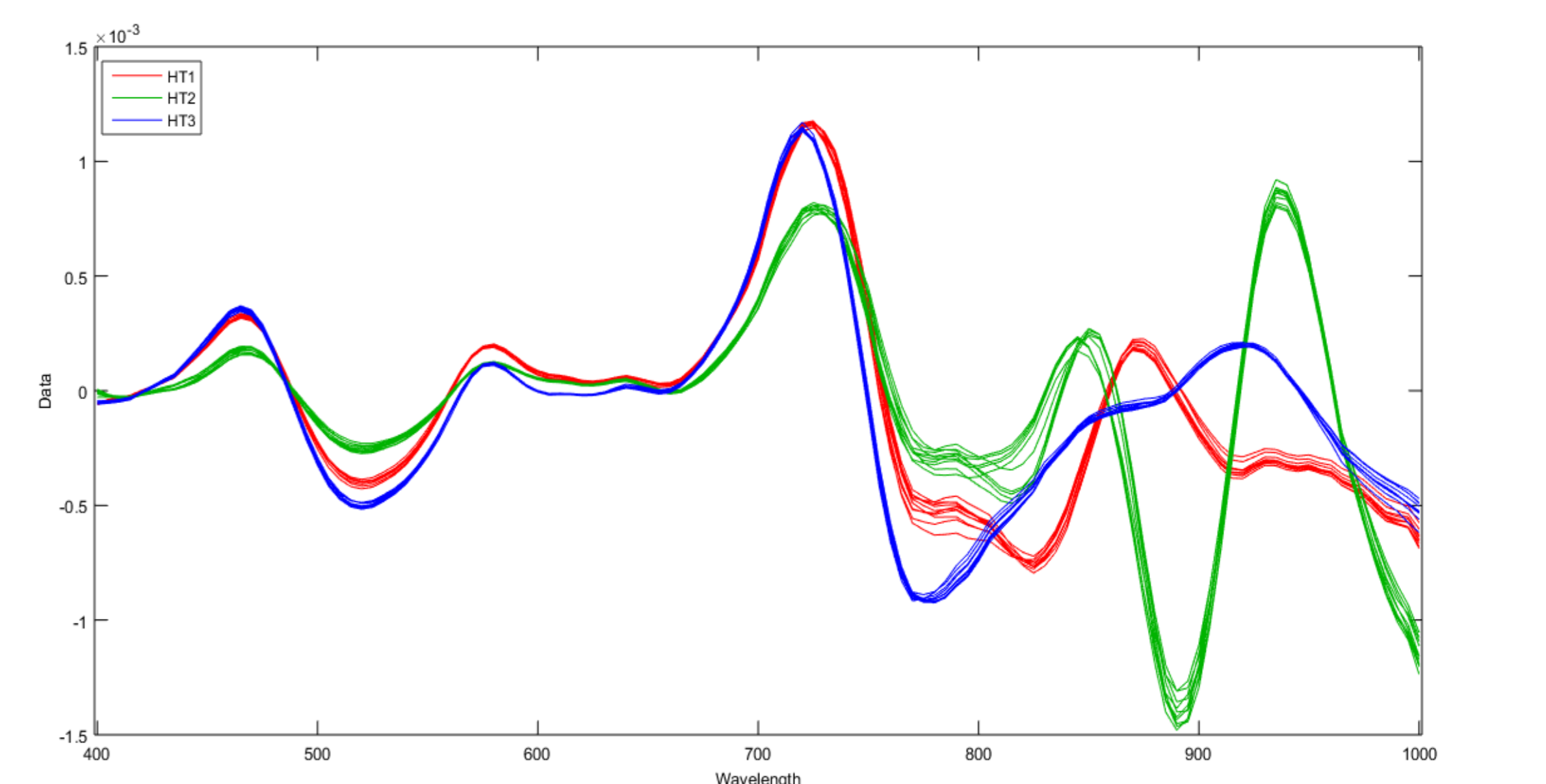
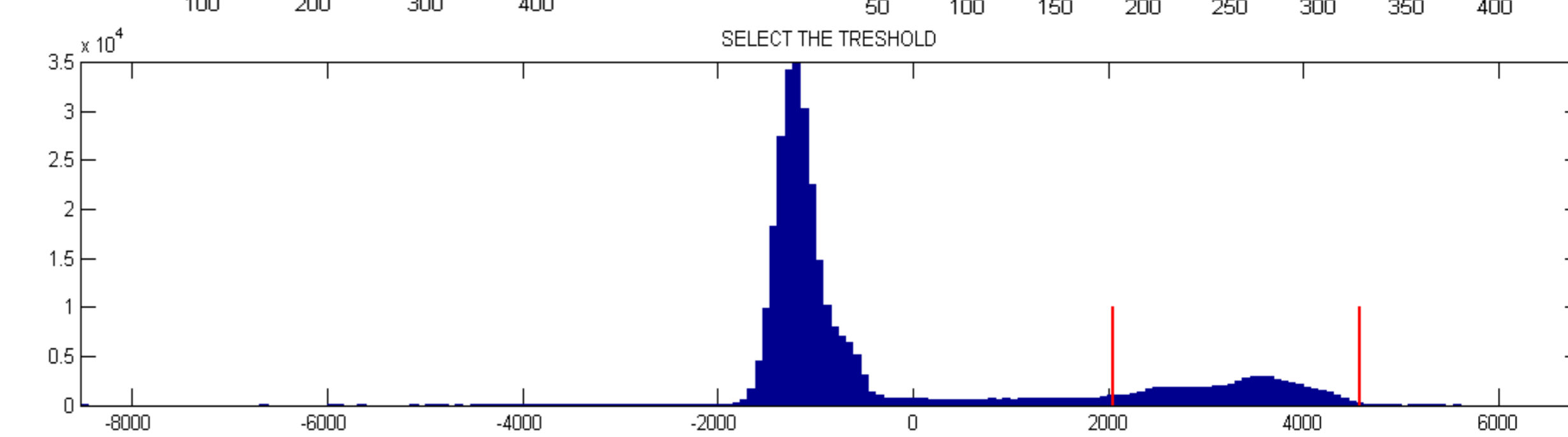
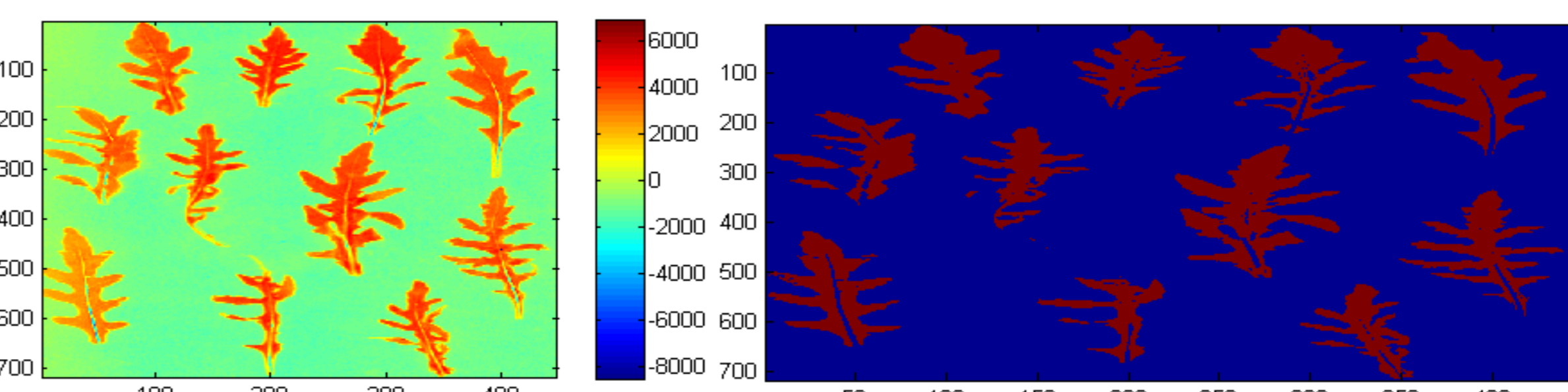
PLSDA was used to classify the samples in 3 CLASSES based on the visual scores (CLASS I: score from 5 to 4, CLASS II: from 3.5 to 3 and CLASS III: score <3, not marketable).

## Rating Scale and quality degradation trend



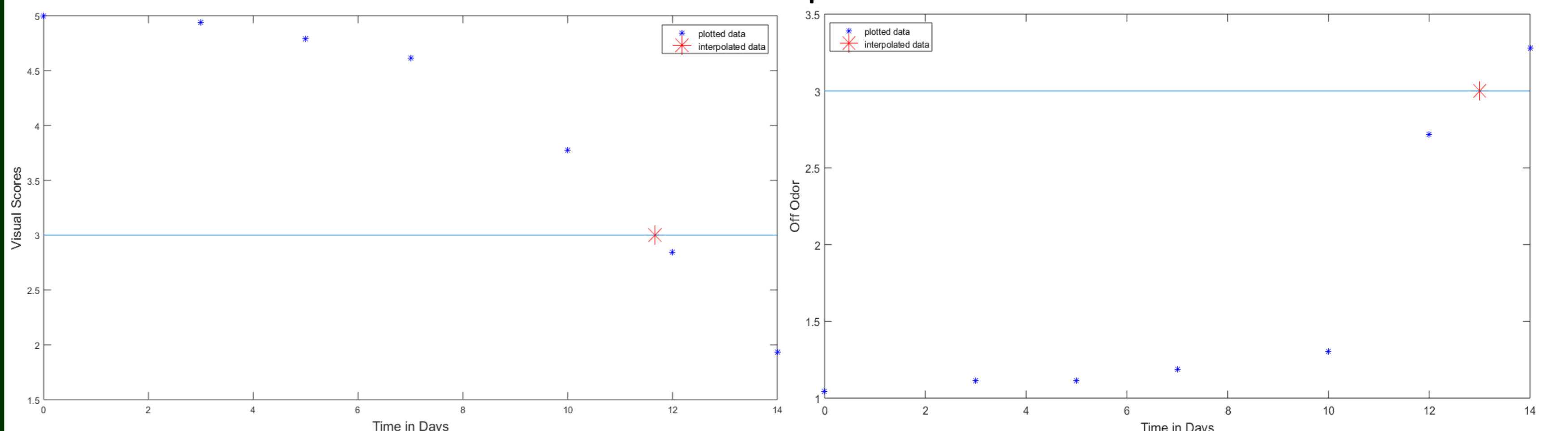
- Score 5 - Excellent**  
Fresh and turgid appearance, bright and uniform green color.
- Score 4 - Good**  
Slight loss of turgidity and fresh appearance.
- Score 3 - Fair**  
Noticeable loss of turgidity and possible slight loss of green color.
- Score 2 - Poor**  
Severe loss of turgidity. Wrinkling and yellowing of leaf blades.
- Score 1 - Very Poor**  
Severe yellowing of leaf blades and wilting. Possible appearance of decay.

Limit of marketability: 3  
Limit of edibility: 2

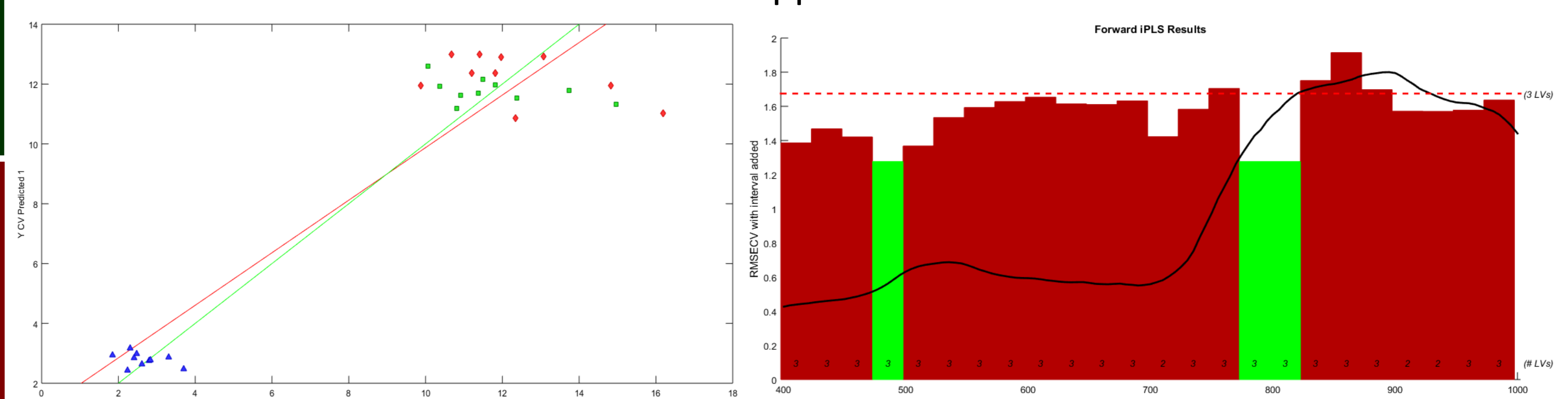


PLS model parameters for shelf-life	#LV	R <sup>2</sup> fit	R <sup>2</sup> CV	RMSEC	RMSECV
APPEARANCE SCORE (Smoothing+2° Derivative)	3	0.89	0.86	1.58	1.73
OFF ODOR (2° Derivative)	3	0.78	0.76	3.54	3.63

## Shelf-life interpolation.



PLS regression line and iPLS variable selection results for shelf life based on appearance score



**Results:** In order to estimate the potential shelf-life on the initial samples a PLS calibration model was developed having as Y variable the days of shelf-life, calculated interpolating the kinetic curve over time. As example, results showed that in case of appearance scores for EXP. 1 the shelf life was 11.66 days while in case of Off-odor the marketability threshold was reached on day 13, indicating as appearance change can be considered the shelf-life limiting factor of rocket leaves. For appearance models, R<sup>2</sup> of 0.89 and of 0.86 with the RMSEC and RMSECV of 1.58 and 1.73 respectively were achieved, whereas the model based on off-odor yielded higher values of RMSEP=3.54 and RMSECV=3.63 and lower values of R<sup>2</sup>. A further variable selection method with forward iPLS was applied to detect the wavelengths yielding the highest weightage in the model, which for appearance score corresponded to the ranges 470-500 and 770-820 nm.

The study provided good potential results for the further studies of the potential of hyperspectral imaging to be applied for shelf life prediction and quality discrimination on line of rocket leaves.