



Monitoring changes during fruit storage using correlative rapid methods

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INTRODUCTION

- Apricot (*Prunus armeniaca* L.) is a prominent stone fruit
- It is characterized by moderated energy content, high, dietary fiber, antioxidant and mineral content
- The most important quality attributes are sugar-acid ratio, richness in flavor, firmness
- In determining the physiological condition and quality of fruits, the so-called fingerprint-based, correlative methods prove to be successful

AIMS

The aim of the research was to develop NIR spectroscopy-based models for the rapid and accurate determination of:

- certain physicochemical attributes of different apricot varieties,
- different ripening stages and batches,
- storage for different periods of time.

MATERIALS AND METHODS

Fruit samples

- Apricot varieties: **Bergeron**, **Bergerouge** and **Zebra**
- Fruit maturity stages: **tendering**, **ripe for consumption**, **ripe for processing**
- Fruits ripe for processing were stored for **1 and 2 weeks**

Physicochemical measurements on the greener and redder sides of the fruits

- Firmness and CIE L* a* b* values
- normalized difference vegetation index (NDVI)
- normalized anthocyanin index (NAI)
- Soluble solid content (°brix) and pH

Near infrared spectroscopic analysis (NIRS)

- PMC Spectralyzer 10-25 infrared spectrophotometer
- Spectral data collection in the 1000-2500 nm range
- Samples were measured on the greener, redder sides and on cut fruit surface

Data analysis

- The combined pretreatment of the NIR spectra was optimized in the 1000-1600 nm wavelength range
- Linear discriminant analysis (LDA) - classification by apricot variety, maturity, and storage time.
- Partial least squares regression (PLSR) – prediction of physicochemical parameters

RESULTS AND DISCUSSION

LDA classification of apricots

- The combination of Savitzky-Golay smoothing (2nd order polynomial, 13 points) and 1st derivative (2nd order polynomial, 13 points) spectral pretreatments gave the most accurate results.
- The apricot varieties were discriminated with an accuracy of 75% for recognition and 68.87% for prediction (Figure 1a).
- The classification accuracies of fruit maturity were between 68.35-88.36% for model building and 33.3-56.66% for validation, by cultivar (Figure 1b).
- The storage time was distinguished with 78.32 to 100% accuracy in model construction, and with 76.78 to 83.4% accuracy in validation, by cultivar (Figure 1c).

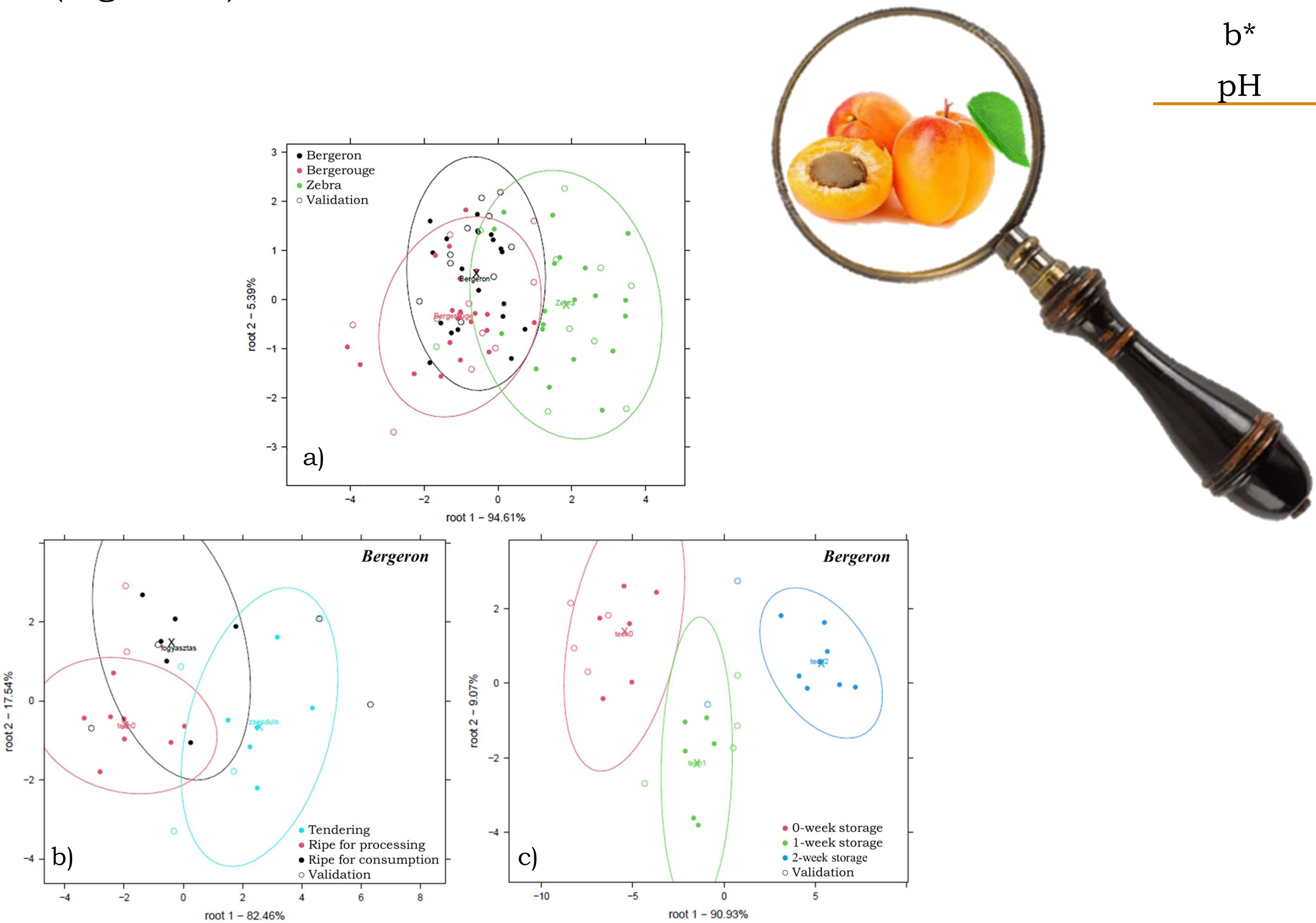


Figure 1. LDA classification based on **a)** apricot variety; **b)** fruit maturity; **c)** storage time

PLSR prediction of physicochemical parameters

- The predictive models estimated L*, b* and pH values with acceptable accuracy from the several measured fruit quality attributes.
- The R_{CV}² and RMSECV values were between 0.36-0.54 and 0.59-3.42 (Table 1, Figure 2).
- Only the pH could be estimated relatively accurately from all sides of the apricot, especially on cut surface.

Table 1. Results of NIRS-based PLSR prediction of some selected physicochemical parameters of apricot

Property	Measurement side	Components	R _C ²	RMSEC	R _{CV} ²	RMSECV
L*	Greener+redder	3	0.48	3.16	0.39	3.42
b*	Redder	3	0.45	2.92	0.36	3.16
pH	Cut surface	10	0.76	0.43	0.54	0.59

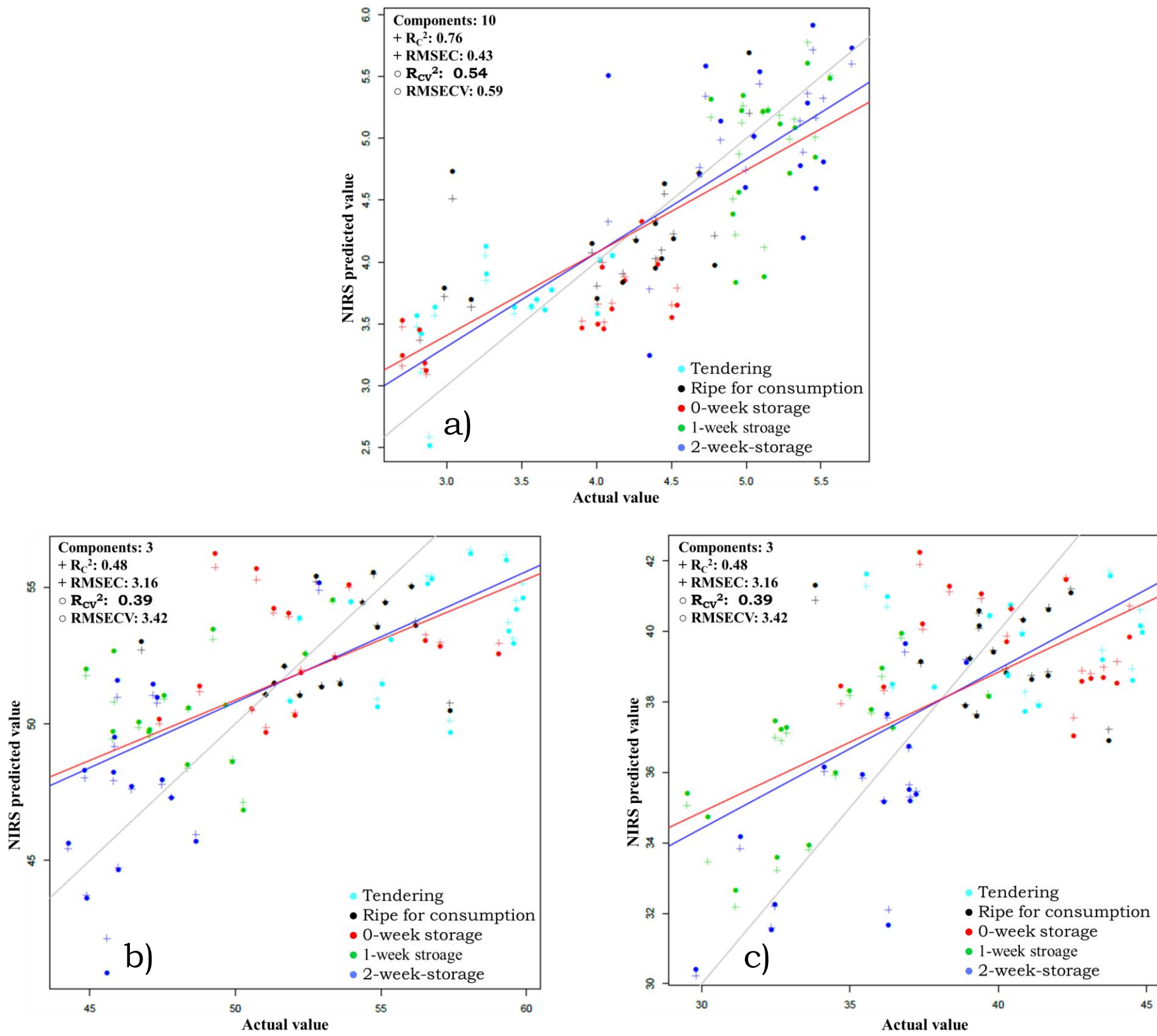


Figure 2. PLSR predictions of some selected physicochemical parameters of apricot **a)** pH; **b)** L* value; **c)** b* value

CONCLUSIONS

- After multiple spectral pretreatments, NIRS proved to be effective in classification of apricot varieties, fruit maturity, and storage time.
- The feeble predictions could be explained by the relatively low natural variability of the tested fruits and the small sample number.
- Further experimental design and data analysis optimization is required.

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