Aquaphotomics to discriminate Pink Lady® and Golden Delicious apples after different storage protocols

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Storage conditions play an important role in determining apple (Malus domestica L.) fruit quality at consumption, and a wrong storage could easily depreciate their commercial value. Several published studies have highlighted the potentiality of NIRS for the analysis of quality parameters in apples and for the determination of their storage type and duration.
The aim of this work was to confirm that NIR spectroscopy is a suitable tool for the discrimination of apples stored under different conditions and to investigate the WAMACs involved.
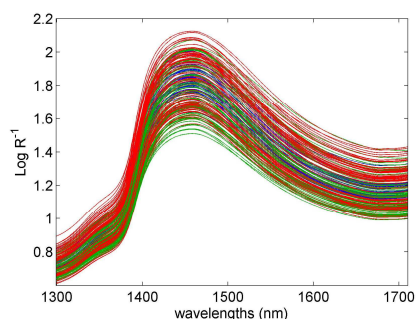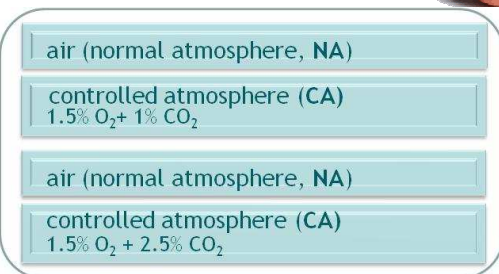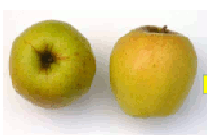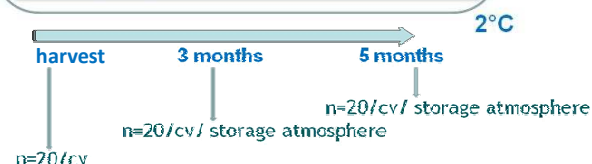
MATERIALS and METHODS

94 apples cv Pink Lady®

100 apples cv Golden Delicious

- air (normal atmosphere, **NA**)
- controlled atmosphere (**CA**) 1.5% O_2 + 1% CO_2
- air (normal atmosphere, **NA**)
- controlled atmosphere (**CA**) 1.5% O_2 + 2.5% CO_2

Spectra were acquired in reflectance mode, twice on three slices of the same fruit, over the NIR range from 1000 to 2500 nm, at room temperature using a FT-NIR (NIRFlex N500, Büchi, Italy) equipped with a fibre probe Only the range from 1200 to 1700 nm was considered

harvest   3 months   5 months   2°C
n=20/cv
n=20/cv/ storage atmosphere
n=20/cv/ storage atmosphere

PLSDA was used to discriminate fruits stored under different conditions, on the basis of different storage atmosphere by means of the PLS_Toolbox (Eigenvector Research, Inc USA) software.

RESULTS and DISCUSSION

Preprocessing: 2nd Derivative (order 2, windows 21 pt) - 5 LV
CV: venetian blinds w/ 10 splits.

	Fresh	Stored
Sensitivity (Cal):	0.922	0.950
Specificity (Cal):	0.950	0.922
Sensitivity (CV):	0.864	0.725
Specificity (CV):	0.725	0.864
Class. Err (Cal):	0.064	
Class. Err (CV):	0.206	
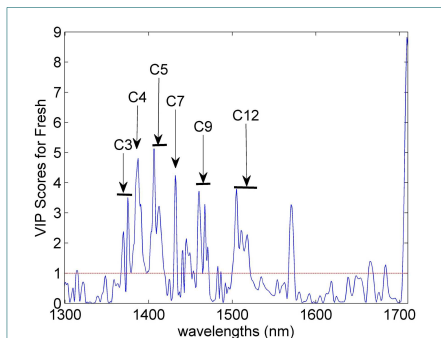
In discriminating fresh and stored fruits both C5 and C12 water matrix coordinates, which correspond to free (S_0) and bound (v_1, v_2) water molecules, are activate with major importance for the first . Conversely in discriminating stored fruits in different atmosphere, free water molecules showed less importance.

Differences between fresh and stored fruits activate the C7 (H_5O_2) and C9 (water trimers), water matrix coordinates; differences between fruits stored in natural or controlled atmosphere activate the C8 (water dimers) and C10 (water tetramer) water matrix coordinates.

CONCLUSION

The results of this work confirm that NIRS could be a suitable tool for classifying apples according to the storage duration or conditions.
In addition Aquaphotomics has been shown to be a useful tool for understanding the phenomena that occur during the storage under controlled atmosphere.
In stored fruits it seemed that the organization of water molecules involves more hydrogen-bonded water than in fresh fruits.

Preprocessing: MSC - 12 LV
CV: venetian blinds w/ 10 splits.

	NA	CA
Sensitivity (Cal):	1.000	1.000
Specificity (Cal):	1.000	1.000
Sensitivity (CV):	0.938	0.946
Specificity (CV):	0.946	0.938
Class. Err (Cal):	0	
Class. Err (CV):	0.058	
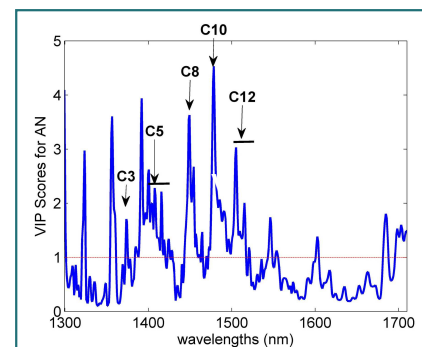
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