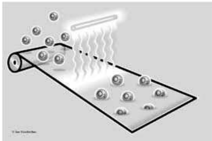
The study of food packaging decay using Water Absorption Pattern (WAP)

Tiziana M.P. Cattaneo,[1] Katia Cremonesi,[2] Maurizio Grassi,[1] Stefania Barzaghi [2]

[1] Consiglio per la Ricerca e la sperimentazione in Agricoltura, CRA-IAA, Milan, Italy

[2] Consiglio per la Ricerca e la sperimentazione in Agricoltura, CRA-FLC, Lodi, Italy



INTRODUCTION

Food packaging carries out the well-known and established functions of containment, protection and handling facilitation of the food packaged inside. With the passing of time, new functions have arisen, mostly derived from the needs of the always changing society. Therefore, the packaging has currently an important hedonistic function, basically related on the driving force of marketing.[1] Further, has to be mentioned the communicative function of packaging, often times defined as the '*silent seller*'. Recently, new functionalities have been ascribed to the packaging, due to a new vision of the package itself. Indeed, it appears a passive component no longer, being nowadays considered as an active part of the environment/packaging/food system. In other words, it is now able to interact both with the external environment as well as with the food inside, taking advantage of its privileged intermediate position. New solutions take into account new concepts of smart, active and/or eco-friendly food packaging materials. Fast methods able for classifying, sorting, and identifying the quality and the stability characteristics associated to the different materials are requested along the food chain in order to validated their properties. [2,3]

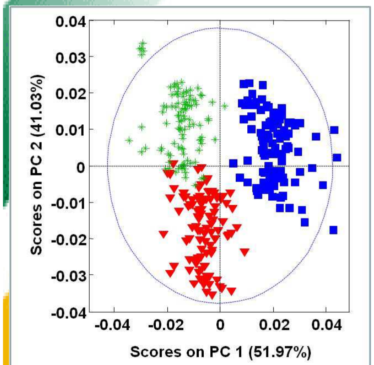
AIM

- ✓ To find differences in the spectra of food packaging materials from different sources, which provide the basis of a "fingerprint" method to classify papers into different "families"
- ✓ Monitoring food packaging quality
- ✓ Characterization and stability food packaging materials

MATERIALS & METHODS

A total number of 150 paper (P), polytenate-paper (PP), active-polytenate-paper (APP) were collected. The active food packaging sheets were obtained by adding the active natural substance, propolis-based, directly spread on the sheet surface.

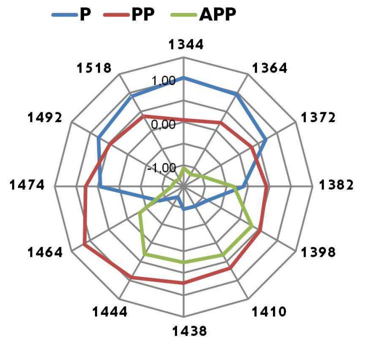
NIRS measurements were performed, using a FT-NIR (NIRFlex N500, Büchi, Italy) equipped with a fibre probe over the range from 10000 to 4000 cm^{-1}. Paper sheets, laid on a reflectance material (Spectralon®), were measured directly on the surface. Spectra from 64 scan were collected with a 4 cm^{-1} resolution and converted in absorbance for further calculation; spectra recorded per sheet were averaged (4 replicates). MSC was applied as spectra pre-treatment. [1]



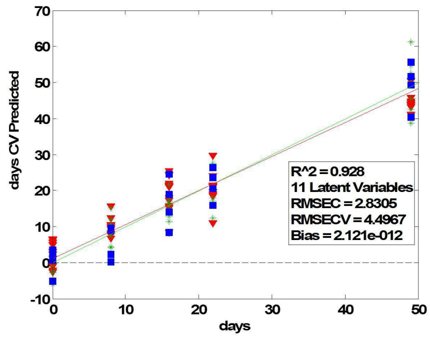
RESULTS & DISCUSSION

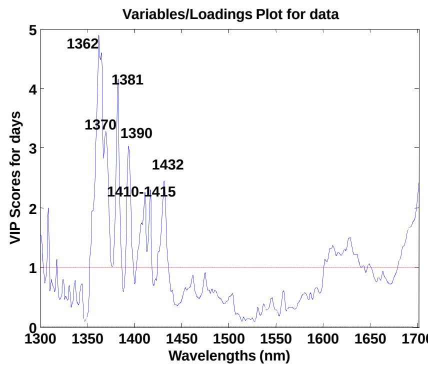
With the aim to verify the NIR ability in classifying the different food packaging materials, PCA analysis (95% Confidence Level) was made on the whole samples set.

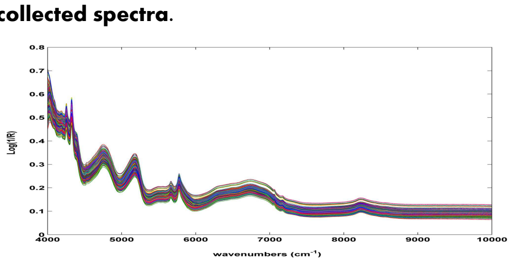
The loading scores (data don't shown) mainly responsible for discriminating among different packaging materials were found corresponding to: 1381 (**dehydration**) and 1432 nm (water molecules with two-H bonds). [5] The related Aquagram confirmed the possibility to use Aquaphotomics in sorting different materials. These data support the relationship between NIR water absorption and packaging permeability characteristics.



Confirmation about the existing relationship between NIR data and time of ageing, already reported in literature, [4] was highlighted by appying PLSR to the whole set of collected spectra.



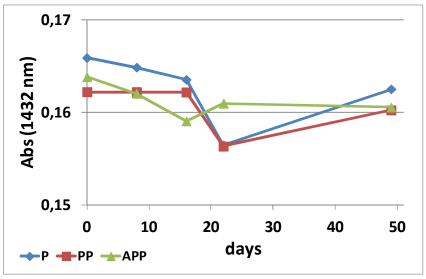




Examples of the collected NIR spectra: samples of different food packaging materials, at different time of ageing (from 1 to 50 days).

Analysing the VIP scores associated to PLRS, a specific Water Absorption Pattern seemed to mainly contribute to the found correlation between NIR data and time of ageing.

With the aim to identify a simple parameter able to monitor the stability of food packaging materials, and the influence of the addition of the "active compound (propolis-based)" on their response during the time, NIR data collected at 1432 nm (number of water molecules with two H-bonds), [5] were plotted against days of ageing.



CONCLUSIONS

Aquaphotomics approach allowed the monitoring of food packaging decay on the basis of water absorption variations detected at 1432 nm. It was also highlighted that the addition of a natural active antioxidant compound, such as propolis extract, can positively influence the food packaging stability over time.

REFERENCES

1. Cattaneo, T.M.P., Cremonesi, K., Barzaghi, S., (2014). NIRNews, 25 (1), 7.
2. Tsuchikawa, S., (2007). Applied Spectroscopy Reviews, 42, 43.
3. Piergiovanni, L., Limbo, S., (2004). Packaging Technology and Science, 17, 155.
4. Ali, M., Emsley, A.M., Herman, H., Heywood, R.J., (2001). Polymer, 42, 2893.
5. H. Maeda et al. J. Near Infrared Spectroscopy, 3, 191-201 (1995)

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