Food ageing monitoring through the use of vibrational spectroscopy and Principal Component Analysis

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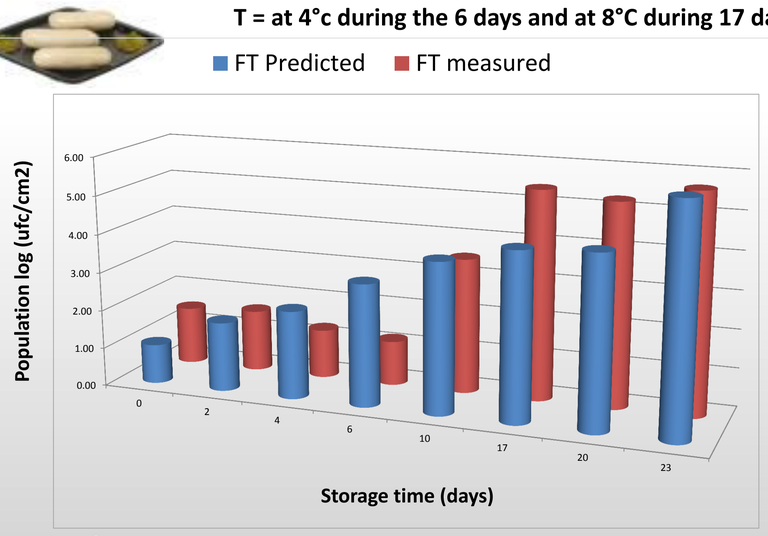
The characterization of food products during and after aging/conservation processes is very important for professionals in the food industry sector to assure a good quality product as well for consumers looking for food insurance. The monitoring of food ageing is necessary in order to bring more specific knowledge about preparation and preservation as well as to better understand the mechanisms governing the alteration of food products. Researches made within the framework of the CONSALIM [1] and POLYOIL [2] regional projects aim to adapt conservation methods to food conservation requirements.

In this direction, the work presented here consists on the development and application of vibrational spectroscopy techniques as rapid and non-destructive analytical procedures combined with chemometric tools. Multivariate tools have been used to explore data collected during the preservation of different food products. The work has been carried out on different matrices such as linseed oil, minced meat, meat products (ham, pudding), beer, etc.

PLS regression models for the prediction of total flora of white pudding during storage based on NIR spectra

T = at 4°c during the 6 days and at 8°C during 17 days

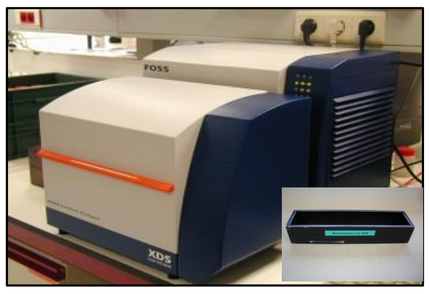


R^2=0,81, RMSECV = 0,98, RMSEP = 1,14

Results show the potential of NIR spectroscopy to predict microbiological changes of white pudding

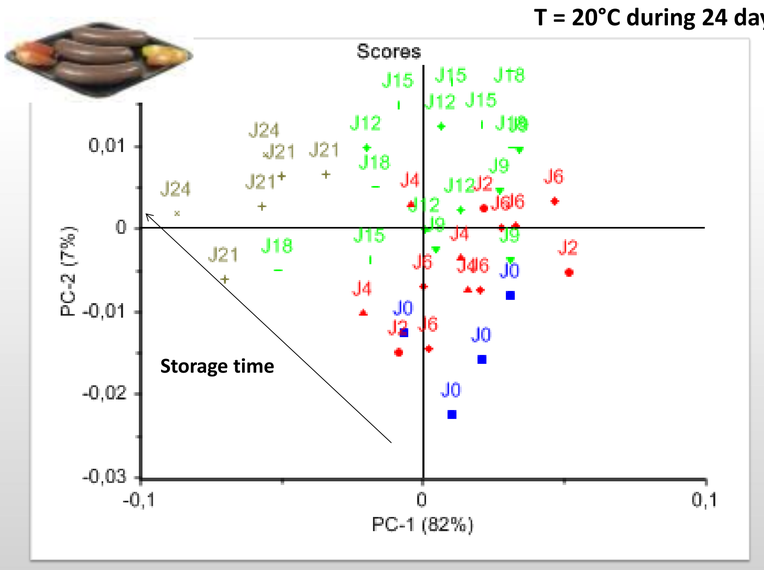
MIR SPECTROSCOPY

NIR SPECTROSCOPY



PCA models based on NIR spectra for studying the differentiation of black pudding in function of their storage time

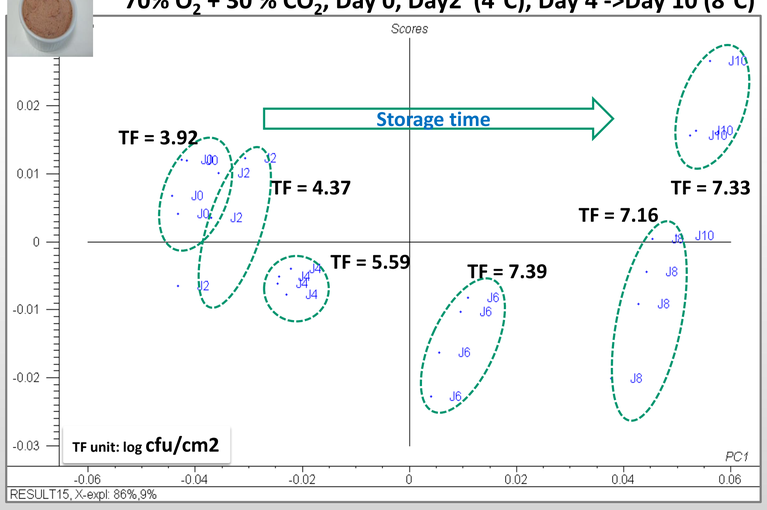
T = 20°C during 24 days



Samples of white pudding distributed according to storage time

PLS regression models for the prediction of total flora of minced meat during storage based on NIR spectra

70% O_2 + 30 % CO_2, Day 0, Day2 (4°C), Day 4 ->Day 10 (8°C)



Samples of minced meat distributed according to their storage time and in a good agreement with the evolution of total flora values

Spectroscopic data

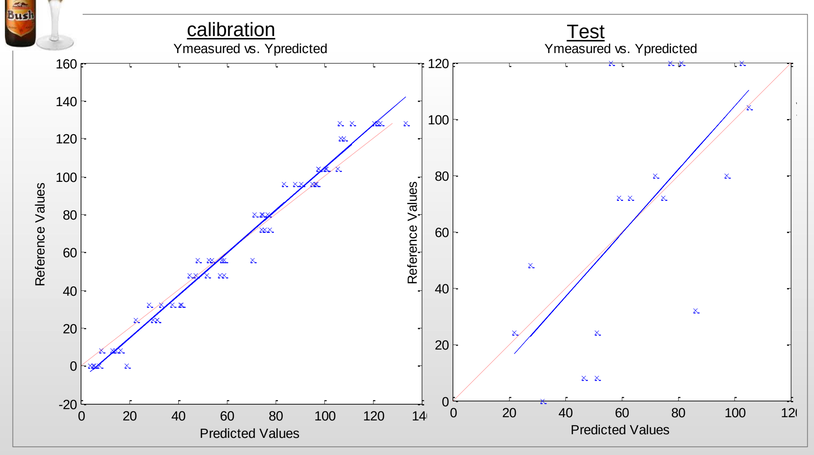
Chemometric pre-treatments
(*SNV, derivative, smoothing..*)

Chemometric treatment
(*PCA, PLS-R, SVM*)

Analytical answer

SVM regression models for the prediction of beers ageing based on MIR spectra

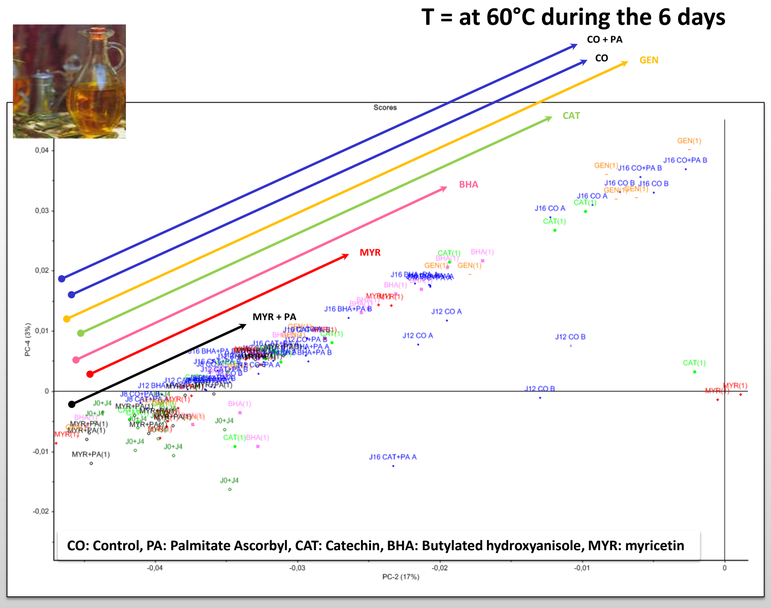
T = 60°C during 6 days (144 hours)



Good correlation between MIR spectra and aging time of beers

PCA model based on MIR spectra for studying the influence of different antioxidants on linseed oil during storage

T = at 60°C during the 6 days



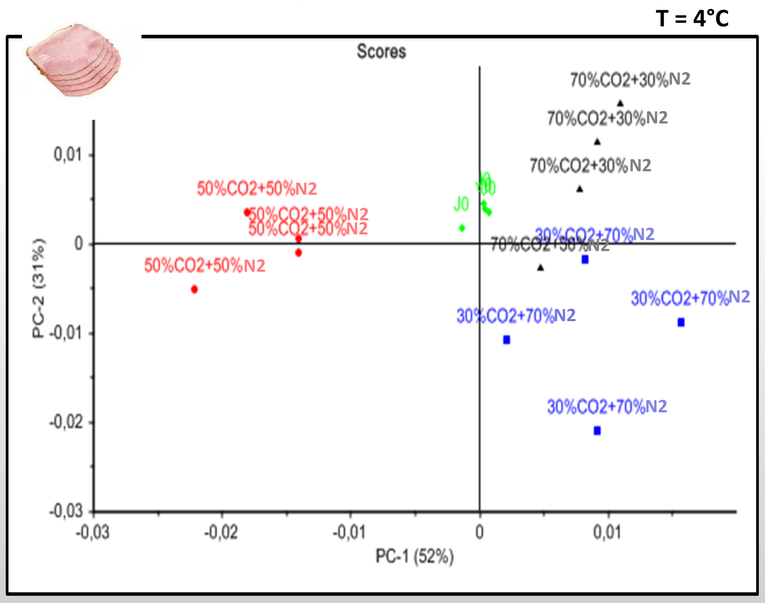
Myricetin seems to be the most effective antioxidant for the protection of linseed oil during storage

In light of the present results, near and mid infrared spectroscopy coupled to chemometric tools like PCA, PLS, SVM permit to follow the evolution of food matrices in function of the ageing time. Results are in a good agreement with those of reference methods

Spectroscopy combined to chemometrics can be applied as a rapid method for the monitoring of the evolution of fresh food during storage

PCA model based on NIR spectra for studying the influence of different packaging conditions on ham storage

T = 4°C



Samples of ham stored during 24 days can be distinguished in function of their packaging conditions (50/50, 30/70, 70/30, CO_2 et N_2)

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[1] CONSALIM (Walloon project, 2009-2013) Extension of the duration of the life of food through comprehension and control of the mechanisms leading to their adulteration

[2] POLYOIL (Walloon project, 2011-2015) Using natural polyphenols to stabilize oils that are high in polyunsaturated fats

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