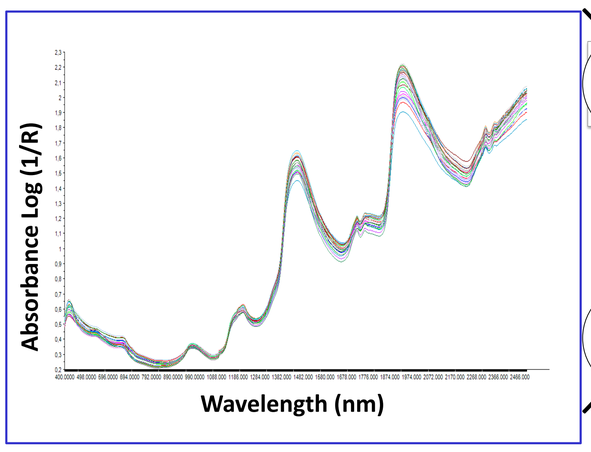
Chemometrics for the evaluation of white pudding ageing on the basis of near infrared spectroscopy

O. Abbas*[1], Y. Adolphe[2], J.A. Fernández Pierna[1], A. Clinquart[2], G. Daube[2], V. Baeten[1], P. Dardenne[1]

[1]Department of valorisation of agricultural products, Walloon Agricultural research centre, 24 Chaussée de Namur, Gembloux, Belgium
[2]Department of Food Sciences, University of Liege, Boulevard de Colonster 20, 4000 Liege, Belgium
E-mail: *o.abbas@cra.wallonie.be*

The comprehension of the mechanisms leaded to food spoilage is necessary in order to bring more specific knowledge to the food producers about preparation and preservation. Researches made within the framework of the CONSALIM* project aim to adapt conservation methods to food conservation requirements. The work presented here consists on the development and on-line application of rapid and non-destructive analytical techniques in order to reach those objectives. The technology used in this work is the well known near infrared spectroscopy combined with Chemometric tools.



- Rapid: few seconds for a spectral measurement
- Simple to use
- Environment friendly: no or little use of organic solvents

+

- Principal Component Analysis PCA
- Partial Least Square Regression PLS

- Extraction of the significant information
- Correlation between spectra and microbiological data

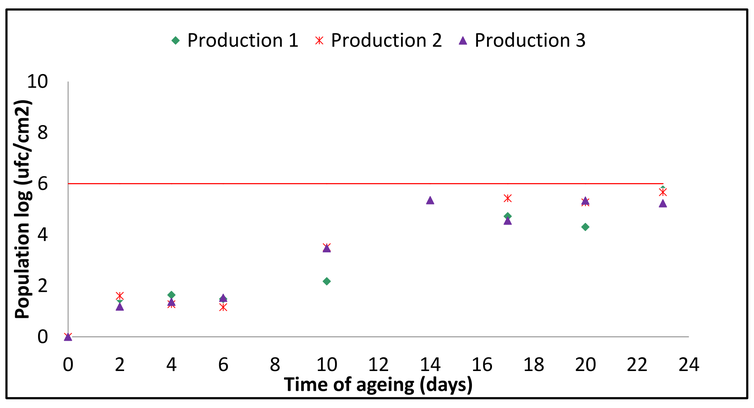
To link the NIR technique and the consumable state of the product, ageing tests of white pudding were carried out and the evolution of the growth of total flora was followed. Those tests were performed on 6 sets of white pudding from two companies. The ageing was studied as presented below. Samples were analyzed by microbiological assays using the reference methods and by NIR spectroscopy. Only the external face of the whiten pudding was analyzed.

Experimental plan

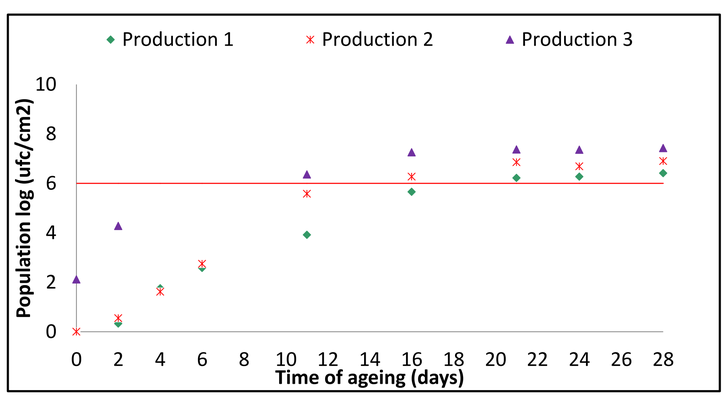
- Company 1 — MAP 1 — Day 1: production 1; Day 2: production 2; Day 3: production 3
- Company 2 — MAP 2 — Day 1: production 1; Day 2: production 2; Day 3: production 3

At 4°C then at 8°C: 23 days / 28 days

Microbiological results

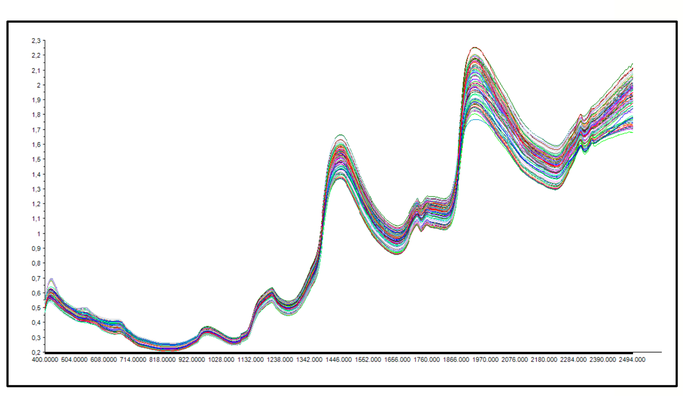


Evaluation of total flora of white pudding (company 1)



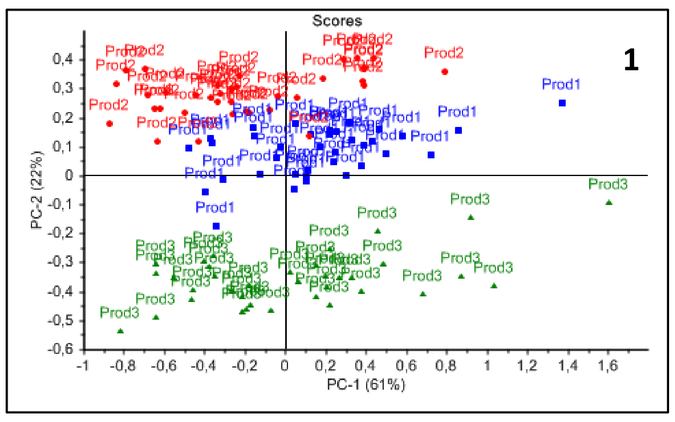
Evaluation of total flora of white pudding (company 2)

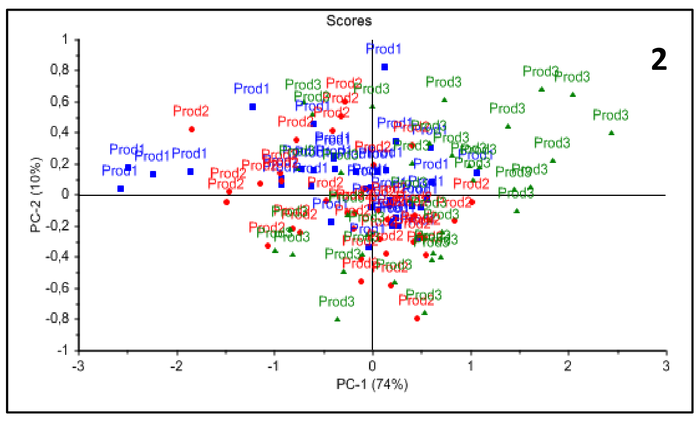
Spectroscopic results



Example of NIR collected spectra of white pudding aged

Distribution of samples of the three productions on the basis of their NIR spectra





Graphs of PCA applied on NIR collected spectra of white pudding aged provided from companies 1 and 2

PCA applied on spectra of companies (1) and (2) shows the variability that can exist in the produced whiten puddings.

Spectra were corrected by first derivative pre-treatment.

Correlation of spectroscopic and microbiological data: individual production sets of each brand

Individual PLS models performances for the prediction of total flora values

Company	pre-treatment	Statistics values	Production 1	Production 2	Production 3
Company 1	SNV+ 1st derivative	R-Square	0,99	0,99	0,97
		RMSECV	0,55	0,78	1,03
		RMSEP	1,34	0,79	1,32
Company 2	SNV+ 1st derivative(1)	R-Square	0,93	0,93	0,99
	SNV(2)	RMSECV	0,91	1,29	**0,55**
	No pre-treatment(3)	RMSEP	1,87	1,21	1,6

PLS models developed on individual productions of each company show good performances for the prediction of the total flora of aged whiten puddings.
calibration set = 24 spectra
Validation set = 12 spectra

Correlation of spectroscopic and microbiological data: Total production sets of each brand

PLS models performances for the prediction of total flora values for all productions

Company	pre-treatment	R-Square	RMSECV	RMSEP
Company 1	1st derivative	0,81	0,95	1,06
Company 2	SNV	0,81	1,35	1,28

PLS models developed on total productions of each company show lower performances for the prediction of the total flora than obtained when working on each production separately.
calibration set =72spectra
Validation set = 36 spectra

Conclusion

Near infrared spectroscopy coupled to chemometric tools has a real potential for the analyses of fresh products. Results obtained on the evaluation of the ageing of whiten pudding are encouraging and studies will be continued in order to better estimate the total flora by the application of other chemometric tools like LS-SVM (Least Squares Support Vector Machines) regression .

CONSALIM (Walloon project): Extension of the duration of the life of food through comprehension and control of the mechanisms leading to their adulteration.

Wallonie

Research Centre Walloon Agricultural