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NON-INVASIVE MULTISPECTRAL IMAGE ANALYSIS FOR THE ASSESSMENT OF SPOILAGE IN POULTRY PRODUCTS

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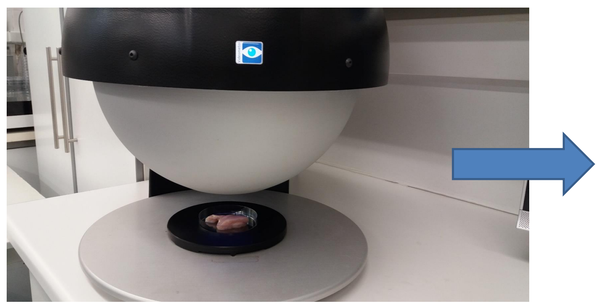
INTRODUCTION

Multispectral image analysis is considered as a potential tool for rapid and no destructive evaluation of the quality of meat products. This alternative method has been applied on a variety of meat products resulting in the development of spoilage predictive models[1,2]. The aim of this study was to correlate microbiological to multispectral data acquired from at-line measurements in a meat processing factory for two poultry products. Partial Least Squares- Regression (PLS-R) analysis was undertaken for the evaluation of the microbiological quality in these products.

MATERIALS AND METHODS

A) Microbiological analysis and Multispectral image analysis

Fillets of chicken thigh (n=97) and chicken burger (n=131) were analyzed microbiologically for the determination of total viable counts (*TVC*) and *Pseudomonas* spp.



- MSI acquisitions were obtained at 18 different wavelengths (405- 970 nm).
- For each monochromatic wavelength, a mean intensity of pixels and the corresponding standard deviation was estimated by CDA (Canonical Discriminant Analysis) algorithm for the desirable ROI (Region of interest) of sample.

RESULTS

Microbiological analysis

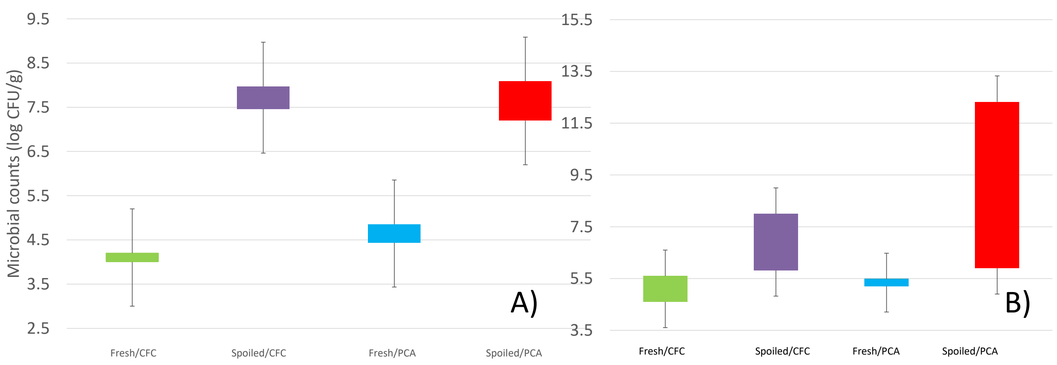


Figure 1: Boxplots of Total Viable Counts (PCA media) and *Pseudomonas* spp. (CFC media) counts (log CFU/g) in fresh and spoiled samples of chicken thigh (A) and chicken burger (B).

- Initial microbial load of TVC and *Pseudomonas* spp. was at 4.3 log CFU/g and 4 log CFU/g respectively in chicken thigh while final number of counts at 216 h were estimated at 9 log CFU/g for TVC and *Pseudomonas* spp.
- For chicken burger, TVC and *Pseudomonas spp.* counts were initially 5.3 log CFU/g and 4.6 log CFU/g respectively. Samples were defined as spoiled at 6.1 log CFU/g (above 96 h) for TVC and at 5.8 log CFU/g for *Pseudomonas* spp.
- At *Figure 3* is depicted the comparison between observed to predicted values (TVC, *Pseudomonas* spp. and time from slaughter) estimated by PLS- R application in data sets of chicken thigh and burger. In addition, for each model are provided values RMSE and R^2 of leave-one-out cross-validation which pointing good performance in all quantitative algorithm.

CONCLUSION

PLS-R models estimating TVC, *Pseudomonas* spp. and time from slaughter indicated good performance according to values RMSE and R^2 for Leave-one-out validation in both cases of poultry products. Hence, the application of these findings in the production and/or distribution line could assist for the proactive assessment of poultry products quality.

REFERENCES

1. Ropodi, A. I. et al., 2016,*Trends in Food Science & Technology*, *50*, 11-25.
2. Tsakanikas, P. et al., 2016, *Talanta*, *161*, 606-614.

B) Data processing

- Partial least squares (PLS) regression was implemented correlating spectral data to microbial counts and time from slaughter.
- For each product, three PLS- R models were developed for the assessment of: 1) TVC (log CFU/g), 2) *Pseudomonas* spp. (log CFU/g) and 3) time from slaughter (log(t)).
- For chicken burger model assessing TVC, SNV transformation was applied at spectra data set in order to reduce noisy and collinear data areas.

MSI acquirement

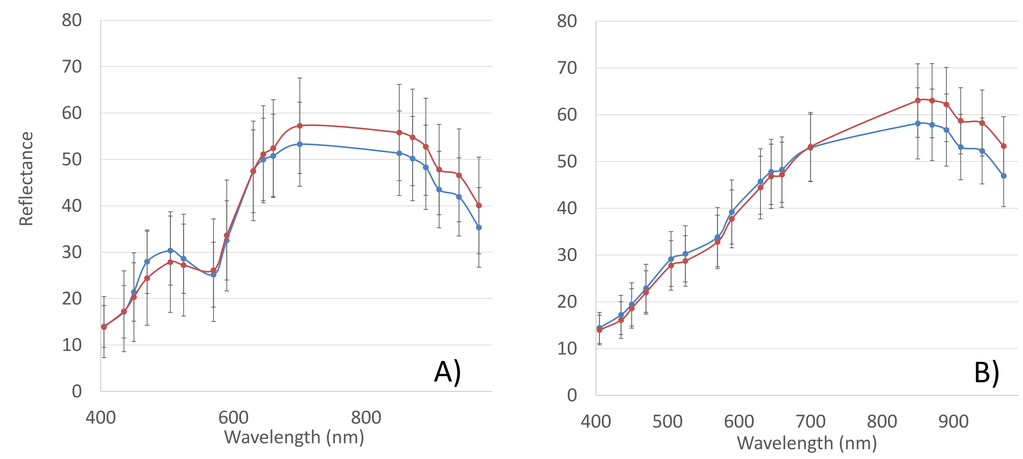


Figure 2: Spectra of chicken thigh (A) and chicken burger (B) at 24 h (blue line) and 216 h (red line) at wavelengths: 405- 970 nm.

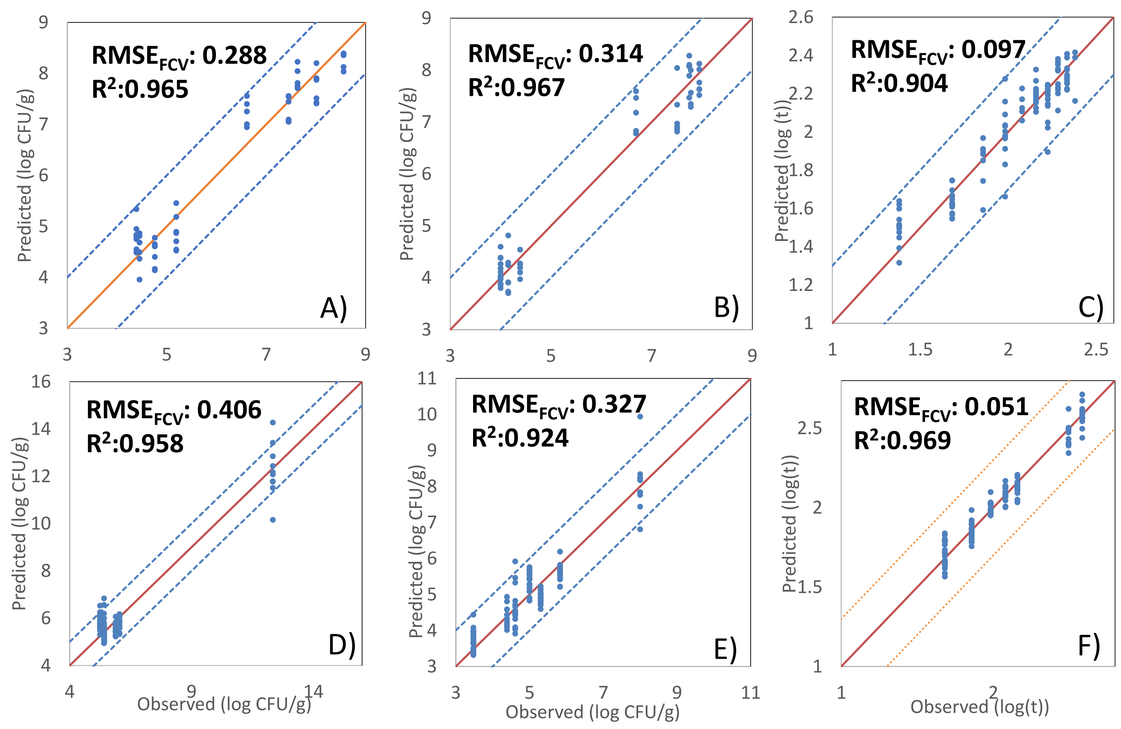


Figure 3: Correlation between observed to predicted values and indexes RMSE and R^2 for the estimation of TVC, *Pseudomonas* spp. and time from slaughter for chicken thigh (A: *TVC*, B: *Pseudomonas* spp., C: time from slaughter) and for chicken burger (D: *TVC*, E: *Pseudomonas* spp., F: time from slaughter), whereas solid line: the ideal y= x line; dashed lines: the 1 log unit area (A,B,D,E)

This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH – CREATE – INNOVATE (project code: T1EDK-04344).

European Union
European Regional Development Fund

EPAnEK 2014-2020
OPERATIONAL PROGRAMME
COMPETITIVENESS
ENTREPRENEURSHIP
INNOVATION

ΕΣΠΑ 2014-2020
Partnership Agreement 2014 - 2020

Co-financed by Greece and the European Union