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Rapid quality assessment of poultry products using at-line Multispectral Imaging

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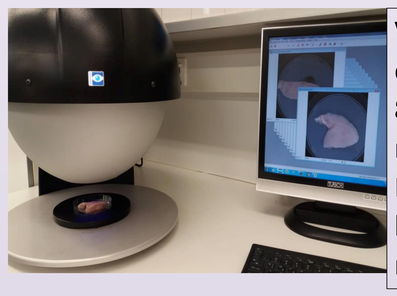
INTRODUCTION

In the last decade non-destructive methods[1] have been implemented in an effort to eliminate food waste due to spoilage while predictive models assessing meat quality have been developed using data from multispectral images[2]. The aim of this study was to correlate microbiological to multispectral data collected from at-line measurements for two poultry products and perform Partial Least Squares analysis for the estimation of their microbiological quality.

MATERIALS AND METHODS

A) Microbiological analysis and Multispectral image analysis

Samples of fillet chicken breast (n=107, 5 batches) and marinated chicken souvlaki (n=134, 4 batches) were selected from the production process and analyzed for the enumeration of total viable counts (TVC) and *Pseudomonas* spp.



Videometer- Lab instrument captures surface reflectance of samples from 18 different wavelengths 405, 435, 450, 470, 505, 525, 570, 590, 630, 645, 660, 700, 850, 870, 890, 910, 940 and 970 nm. The result of this acquirement is a monochrome image with 32- bit floating point precision for each wavelength. Furthermore, Canonical Discriminant analysis is performed in order to exclude background/environment areas[3]. The final spectral data set is comprised of 18 mean reflectance and 18 standard deviation for each sample.

B) Data process and Partial Least Squares- Regression (PLS- R) model development

- Partial Least Squares-Regression (PLS-R) analysis was undertaken by correlating microbial counts and time from slaughter to spectral data (x= 36). The outcome were three separate PLS- R models estimating TVC, *Pseudomonas* spp. counts and time from slaughter for each poultry product.
- For models assessing quality on chicken breast, spectral data were pretreated by Standard Normal Variable transformation (SNV) as an attempt to reduce collinear and noisy data.
- On the contrary, for chicken burgers models, only in the case of TVC's estimation x variables were transformed by Standard Normal Variable transformation (SNV).
- Logarithmic transformation was applied For time from slaughter .

RESULTS

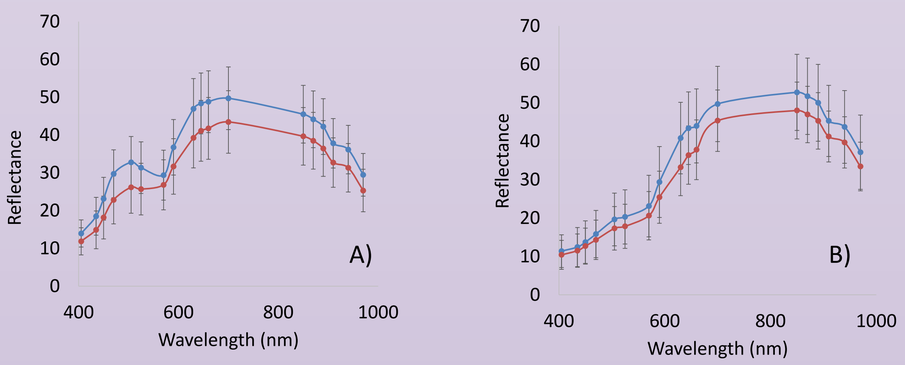


Figure 1: Spectra from MSI application on fresh (24 h from slaughter, blue line) and spoiled (216 h from slaughter, red line) samples of chicken breast fillet (A) and marinated chicken souvlaki(B).

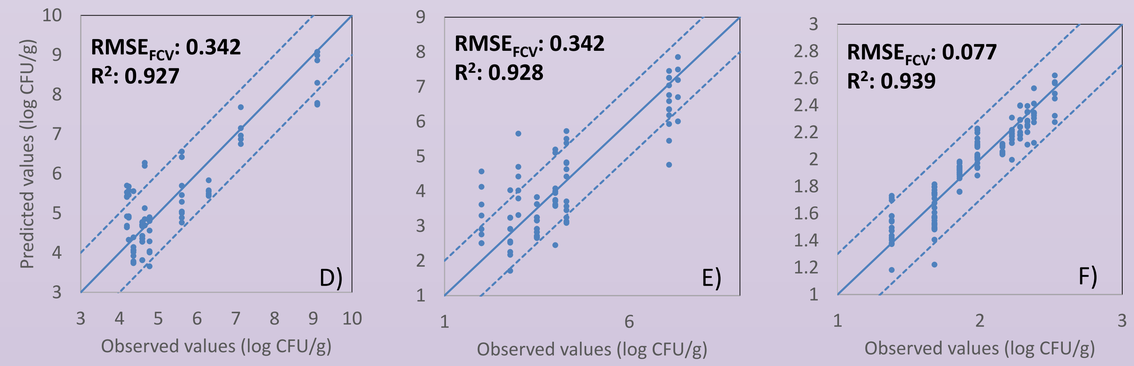


Figure 3: Correlation of observed to estimated values after the implementation of PLS- R model for TVC (A), *Pseudomonas* spp. (B) and time from slaughter (C) for marinated chicken souvlaki. Solid line depictures line y= x and dashed lines are ± 1 log area.

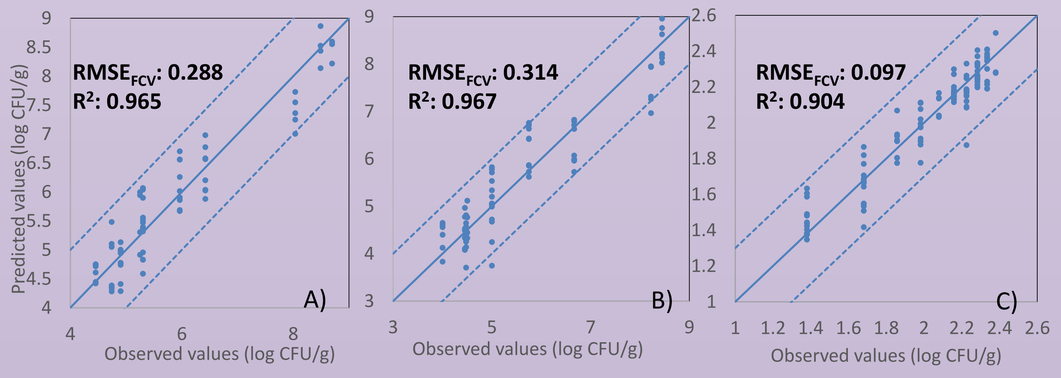


Figure 2: Correlation of observed to estimated values after the implementation of PLS- R model for TVC (A), *Pseudomonas* spp. (B) and time from slaughter (C) for chicken breast. Solid line depictures line y= x and dashed lines are ± 1 log area.

- *Figure 1* and *4* demonstrate that wavelengths 470- 525 and 630-970 nm contributed mostly at the development of qualitative models for chicken breast fillets. Similarly, wavelengths above 630 nm are consisted by important information for marinated chicken souvlaki's quality assessment.
- Models estimating chicken breast fillets TVC, *Pseudomonas* spp. and time from slaughter (*Figure 2*) showed a satisfactory performance.
- For marinated chicken souvlaki models (*Figure 3*), RMSE and R^2 values were lower than 0.342 and 0.939 respectively.

Figure 4: B coefficients influencing PLS- R models for chicken breast fillets (A) and marinated chicken souvlaki (B).

CONCLUSION

PLS-R model performance for both products is considered satisfactory. Consequently, models could be successfully implemented in tandem with Multispectral analysis for the assessment of microbiological quality in poultry products.

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