Influencing wavelength comparison in pls models for the prediction of pork meat quality by vis-nirs

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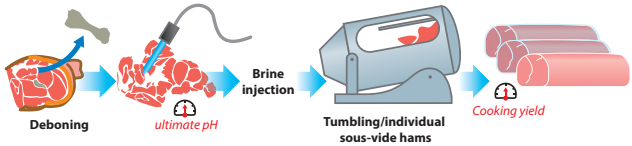
Introduction

For the needs of a running project dealing with hyperspectral imaging, we wanted to define the spectral range specifications of the device being built. The reference data we expect to predict on pork meat cover a wide diversity of parameters: pH, drip loss, cooking yield and intramuscular fat. In previous studies focusing on VIS-NIRS (Visible and Near Infra Red Spectroscopy) prediction of the meat quality, we mainly used the 350-1800 nm spectral range of a Labspec4 spectrometer (ASDI). Because this spectral range seems to be too wide for a single ready-to-use hyperspectral camera, we decided to take another look on our previous NIRS studies and investigate which wavelength are the most predictive. The objective was to make a comparison of the influencing wavelength that are included in the PLS prediction equations, for each of the meat quality parameters we had studied.

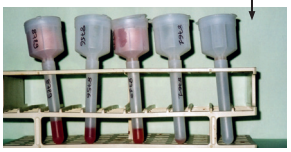
Material and methods

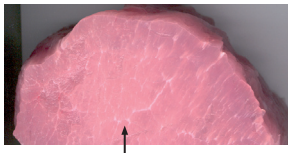
Spectra data base building and reference meat quality parameters:

- 3 studies focusing on NIRS prediction of the meat quality (ASDI Labspec 4)
- Ham Cooking yield (n=170) and ultimate pH of *Semimembranosus* (n=155)



- Drip loss of *Semimembranosus* (n=45 – EZ method)





- Intra muscular fat of *Longissimus Thoracis* (n=100 - NFV-04 403 method)

PLS models comparison:

- Partial Least-Square (PLS) models developed previously were loaded in the Eigenvector PLS Toolbox 7.5 running on MATLAB 7.9.0 R2009b software
- The determination of the most influencing wavelength was performed with the Selectivity Ratio procedure

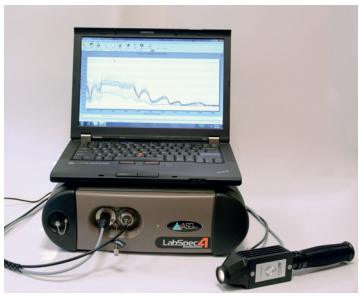


Figure 1 : ASDI Labspec 4

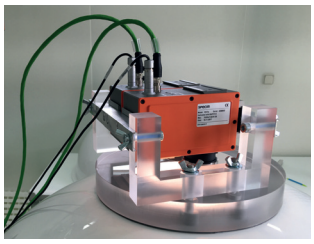


Figure 2 : Hyperspectral imaging project (Fx10 and Fx17 Specim cameras)

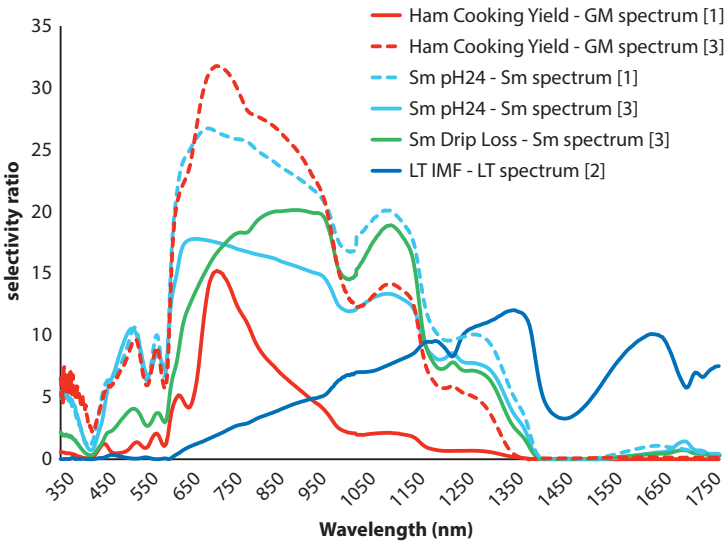


Figure 3: Comparison of selectivity ratio curves from PLS models of prediction of cooking yield, drip loss, ultimate pH, and intramuscular fat. (GM: Gluteus Medius, Sm: Semimembranosus, LT: Longissimus Thoracis)

Results

- A strong gap in the selectivity ratio curves between the IMF prediction model and the other meat quality parameters models (figure 3)
  - IMF selectivity ratio curve has 2 peaks: 950-1400 nm, 1550-1700 nm
  - For pH, drip loss and cooking yield: 3 peaks in the 600-1300 nm range
- Difference of calibration curves could be explained by absorption band of C-H bonds for lipids, and absorption bands of water and proteins for pH and water holding capacity
- For ultimate pH and cooking yield NIRS prediction, the shape of the curves from 2 different studies are very similar. This indicates a high level of robustness of the NIRS models
- Full 350-1700 nm range hyperspectral camera is needed to predict meat quality, from intramuscular fat to pH, drip loss and cooking yield

Conclusion

The analysis of the most influencing wavelength of VIS-NIRS models previously developed gave us an overview of the spectral range involved in the prediction of the meat quality. For upcoming developments with hyperspectral imaging, we can conclude that we need to keep the full VIS-NIR spectral range (350-1800 nm). The next acquisition system we are working on will need the fitting of 2 hyperspectral cameras (Specim FX10 and FX17) to cover this spectral range.