Miniaturized NIRs for age and expiration date prediction of packaged chicken fillets

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Objectives

What type of potential food applications are there with the latest miniaturized Near Infrared (NIR) equipment (Fig. 1 – 2)? And more important: could these applications be useful for industry as well as consumers in the future?

To illustrate this, we performed two types of 'aging' experiments on packed chicken fillets which may have several potential applications in the food safety and authenticity area.

Measurements were performed without opening the package material, through the transparent top-foil.

Figure 1. SCiO 1.0 NIR spectrometer (ConsumerPhysics). Spectral range: 740 – 1070 nm. Smart-phone controlled (Bluetooth), cloud based data acquisition.

Figure 2. MicroNIR 1700 (ES) NIR spectrometer (Viavi). Spectral range: 908 – 1676 nm. Tablet controlled (USB), off-line data processing.

1. Age prediction

Age prediction of a chicken fillet reference set: 10 identical packages directly from slaughterhouse, trained personnel, controlled environment, approx. 350-400 scans/instrument, 5 scans/sample/day.

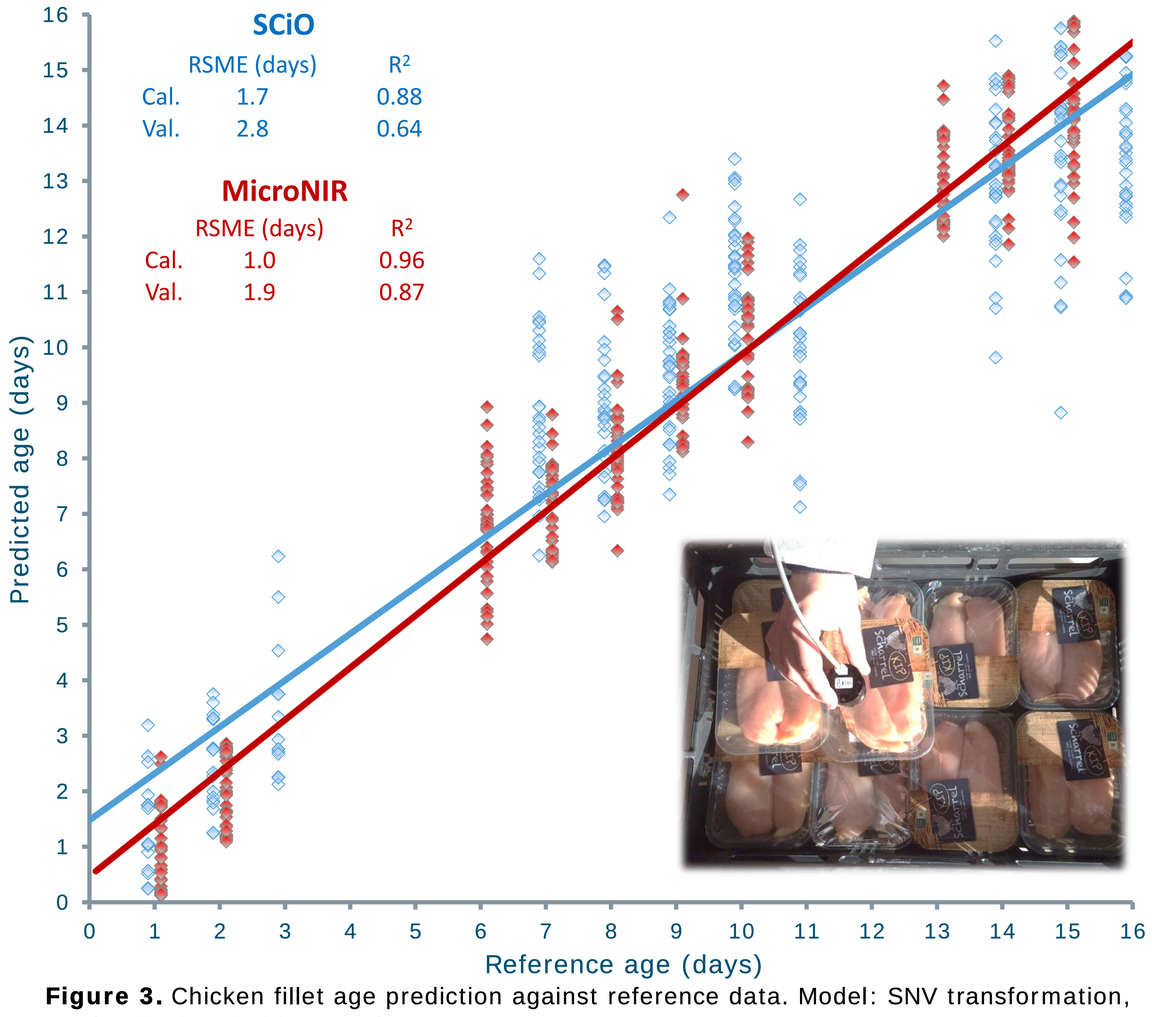


Figure 3. Chicken fillet age prediction against reference data. Model: SNV transformation, epsilon SVR with RBF kernel.

2. Expiration date prediction

Expiration date prediction on supermarket samples: 10 different samples from supermarket, untrained volunteers (7), living room conditions, approx. 800 scans/instrument, 10 scans/sample/day.

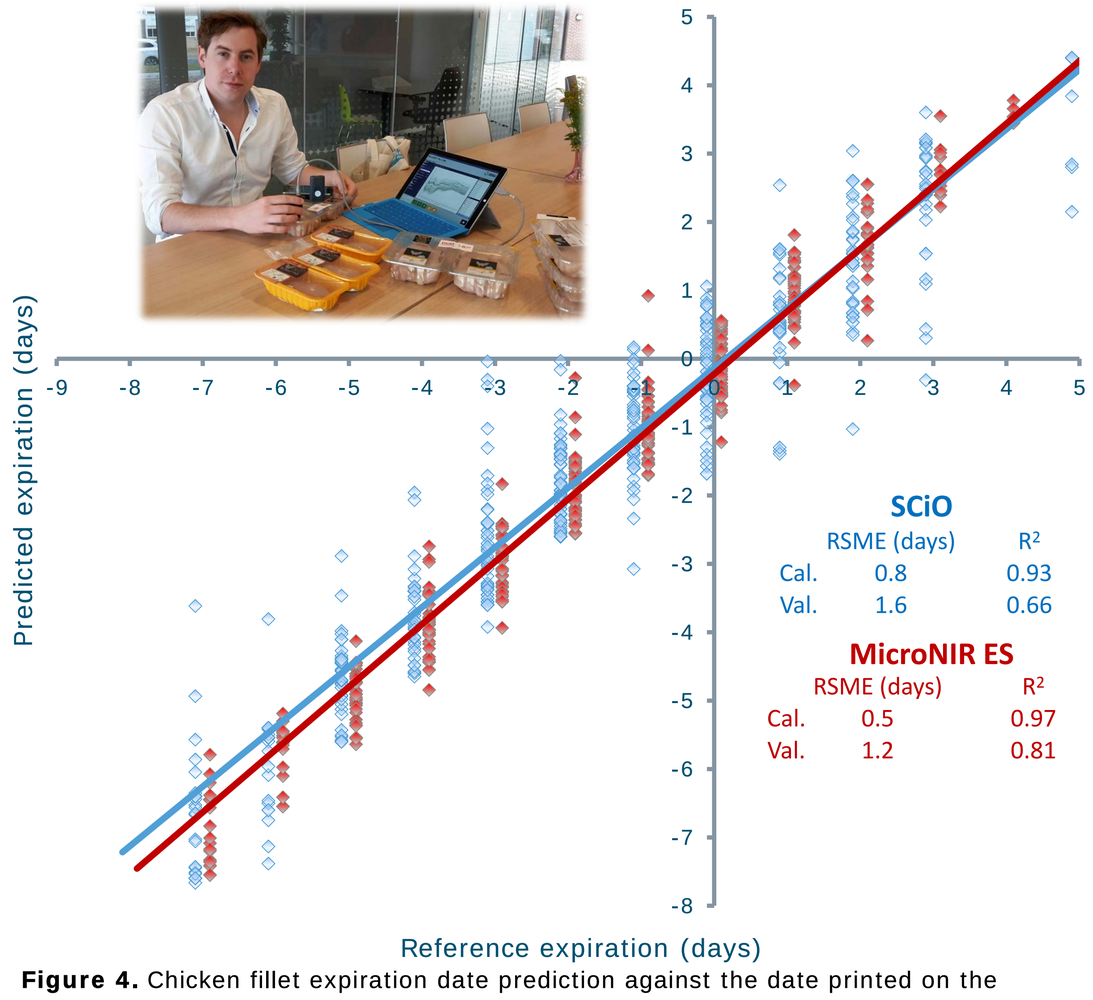


Figure 4. Chicken fillet expiration date prediction against the date printed on the package. Negative numbers represent days prior to expiration, positive numbers after expiration. Zero days is on the expiration day itself. Model: SNV transformation, epsilon SVR with RBF kernel.

Results and Conclusions

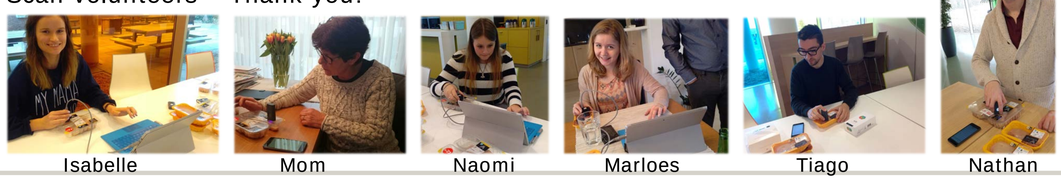
- In both cases support vector regression (SVR) machine learning was applied with a standard normal variate (SNV) transformation. Radial base function (RBF) was the best kernel fit in both cases. More classical regression algorithms like PLSR did not result in a link between age and spectral data.
- In both cases there seems to be a connection between the spectral data and the age of the chicken fillets. For both the reference set (Fig. 3) and the supermarket set (Fig. 4), best results were found with the MicroNIR with an residual mean square error (RSME) of validation of 1.9 and 1.2 days respectively.
- Above pilot cases seem promising to build a NIR application to be used in practise.

Methods

- Chemometrics: The Unscrambler X 10.3 (Camo software). Epsilon SVR grid settings were kept as close as possible, *e.g.* gamma = 1, C = 10, epsilon = 0.1.
- Data acquisition for SCiO was performed using SCiO Lab 1.2.0.19, MicroNIR data was recorded with MicroNIR Pro 2.2.

Acknowledgements

Scan volunteers – Thank you!



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