Estimation of Visible Fat Content in Beef *m. longissimus* Using Near Infrared Spectroscopy

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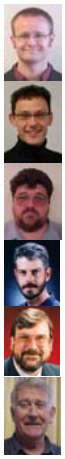

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Background

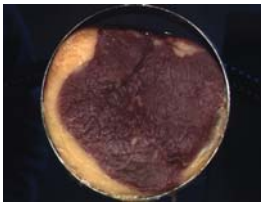
- Near infrared (NIR) spectroscopy is a non-destructive measurement method using reflected light from the sample to determine composition and structure.
- Predictions arising from NIR spectra have been correlated with the tenderness of lean meat[4].
- Other components (fat and connective tissue) contribute to tenderness influencing the prediction.
- Discriminating between lean and other components may assist in improving measurement of tenderness using NIR spectroscopy.

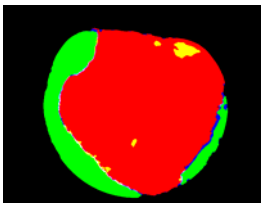
Aim Predict visible fat content in meat using near infrared spectroscopy with visual images as primary reference

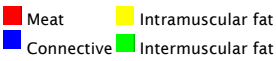
Methods

- Three steers were slaughtered by captive bolt without electrical stimulation.
- Wrapped three pairs of beef *m. longissimus lumborum* in cling film immediately post-slaughter to prevent shortening[2] .
- Each muscle held at 15°C until 24 hours post rigor mortis.
- Positioned in holder and for each successive cut face exposed:
  - Image collected using JAI colour vision camera.
  - Collected 49 near infrared spectra from cut face at 14mm intervals (7 x 7 grid) using a fibre optic diode array spectrometer (KES Analysis Inc).
- Estimated lean and fat content at each grid position using digital colour image analysis methods[3] for use as the primary reference.
- PLS regression[1] with cross validation was used to build a calibration for visible fat using estimated lean and fat content and NIR spectra from three pairs of muscles.
- Cross validation was undertaken on a within animal basis.

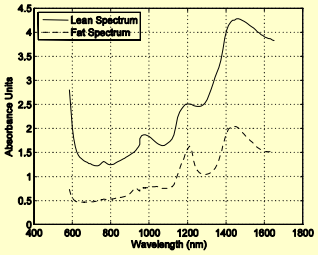
Results



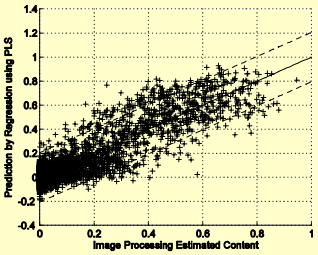




- Image processing used to segment muscle image into lean, fat and connective tissue.



Examples of NIR spectra identified as almost entirely lean or fat



NIR predicted Visible Fat as a ratio of visible fat over the total visible area versus estimate using image analysis. (dashed lines indicate 95% prediction interval)

- Composition of pixels ranged from entirely lean (0) to almost pure fat (1).
- NIR spectra of pixels identified as almost entirely fat or lean suggests that VIS/NIR can discriminate between fat and lean.
- Linear relationship exists between NIR predicted visible fat ratio and image analysis estimate.
- RMSEP* = 0.103 R^2 = 0.81
- Range 0 – 0.94
- Confidence interval approx 21% of maximum prediction.

* Root mean square error of prediction

Conclusions

- **The measurement of visible fat content ratio using NIR spectroscopy shows promise. (RMSEP 0.103)**
- **Estimation of the visible fat content of meat may have potential for automated grading purposes.**
- **Estimation of components other than lean may assist in the objective measurement of meat quality.**

References

1. de Jong, S. (1993). SIMPLS: An alternative approach to partial least squares regression. *Chemometrics and Intelligent Laboratory Systems* 18:251-263.
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3. Gonzalez, R.C. and Woods, R.E. (2002). *Digital Image Processing*, 2nd ed., Prentice Hall, Upper Saddle River, NJ.
4. McGlone, V.A., Devine, C.E., and Wells, R.W. (2005). Detection of tenderness, post rigor age and water status changes in sheep using near infrared spectroscopy. *Journal of Near Infrared Spectroscopy* 13:277-285.