Differentiation of grass fed beef products based on production system of origin using Raman spectroscopy

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Food adulteration is becoming an increasing concern for consumers around the world. Of particular concern, is the adulteration of products which attract a premium price due to their perceived quality. Grass fed beef products are one such food which attract a premium price as some consumers perceive grass fed beef to be a healthier option produced in ethical production systems. Currently, there is no clear auditing system for grass fed beef products in Australia and as a global producer of grass-fed beef, it is critical for the Australian beef industry to be able to verify production system claims for beef products. Thus, a study was undertaken to calibrate Raman spectroscopy as a tool for the verification of production system of beef carcases produced in Australia. Consequently, a study was conducted using spectra collected on 930 beef carcases from production systems including grass fed only, grass supplemented, short term and long-term grain feeding.

The subcutaneous fat at the brisket of each carcase was measured using the Raman device in 3 positions using an integration time of 3s and 5 repetitions. To determine if the spectra could characterise the fatty acid profile, spectra for each carcase were averaged and background corrected to remove non- Raman contributions.

Spectra show differences are evident between grass and grain fed cattle at key wavelengths that characterise fatty acids including 1069, 1125, 1300, 1445 and 1650 cm^{-1}. These differences agree with the previous research conducted by Logan et al. (2020) who found that spectra collected from grain fed carcases demonstrated higher intensities at wavelengths which represent the CH_2 and C-C bonds associated with higher levels of saturated and monounsaturated fatty acids.

While spectral patterns are similar for grass and grain fed cattle at most of these intensities, the peak at 1658cm^{-1} and spectral features around 1069cm^{-1} indicate some similarities are present in spectra collected from short term grain fed cattle and grass supplemented cattle. This suggests the *cis* fatty acids and ratio of omega 3 and 6 fatty acids may be affected by supplementing grass fed cattle (Olsen et al., 2008). Although an association was found between the spectra and production system of origin, further research is required to determine the influence of supplementary feed type, feeding length and carcase location of the measurements on the ability to use Raman spectroscopy as a tool for authentication.

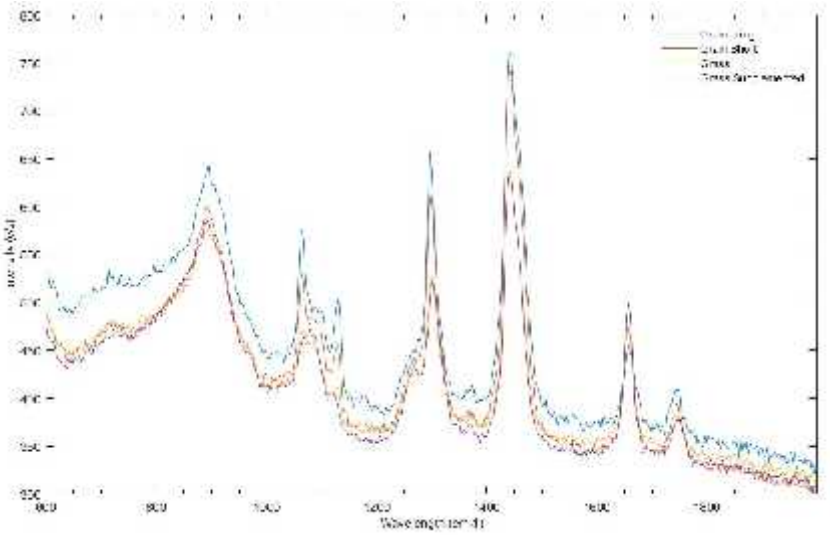

Figure 1. Raman spectra of subcutaneous fat from carcases of cattle from grain fed (long and short) and grass fed (grass only and grass supplemented) production systems.

References

Logan BG, Hopkins DL, Schmidtke L, Morris S and Fowler S M (2020) *Meat Science.* **160**, 107970.
Olsen EF, Rukke EO, Egelandsdal B and Isaksson T (2008) *Applied Spectroscopy*. **62**, 968-74.

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