Preliminary investigation into the prediction of eating quality of lamb loin using Raman spectroscopy

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Introduction: To meet changing consumer demands the Australian lamb industry has undertaken much work, however a lack of data on eating quality remains (Fowler et al., 2018). Raman spectroscopy is a potential tool for prediction of eating quality as it can create a "chemical fingerprint" of proteins, collagen and fats (Abbas, Fernández Pierna, Codony, von Holst, & Baeten, 2009; Fowler, Ponnampalam, Schmidt, Wynn, & Hopkins, 2015) which have been associated with eating quality (Hopkins, Allingham, Colgrave, & van de Ven, 2013; Hopkins, Hegarty, Walker, & Pethick, 2006). Therefore, a study was conducted to determine the potential for Raman spectroscopy to predict the eating quality traits of lamb loin.

Materials and Methods: Loins from 48 lamb carcases were collected 24 hours post-mortem and scanned using a Mira® hand-held Raman device in 3 positions perpendicular to the muscle fibres with an integration time of 3s and 5 repetitions. Slices were excised and frozen prior to analysis by 60 untrained consumers as described by De Brito et al. (2016). Sensory panel data and spectra were averaged per loin before analysis by partial least squares analysis to predict tenderness, juiciness, flavour and overall liking.

Models demonstrated a high correlation between the predicted and measured tenderness scores (R2 = 0.90, RMSE = 3.42) flavour (R2 = 0.88, RMSE = 2.85) and overall liking (R2 = 0.88, RMSE = 3.26). However, a poor correlation between predicted and measured was found for juiciness (R2 = 0.05, RMSE = 9.11). Examining the PLS loadings of these models highlighted that variation in overall intensity were evident, yet wavelengths present at 1256, 1348, 1430, 1450, 1505, 1538 and 1653cm-1 were the main spectral features of the prediction for tenderness. However, wavelengths evident at 1438, 1538, 1559 and 1651 cm-1 contributed most to the prediction of flavour and those at 1256, 1430, 1538 and 1653cm-1 contributed most to the prediction of overall liking.

Results and Discussion: As little research has been completed to determine the potential for Raman spectroscopy to predict eating quality, it is difficult to understand the implications of the peaks in terms of the underlying characteristics of the meat which relate to eating quality traits. However, research has shown that peaks at 1438 and 1650cm-1 are associated with differences in fatty acid composition (Fowler et al., 2015; Logan, Hopkins, Schmidtke, & Fowler, 2020) which contributes to overall liking, flavour and tenderness due to their correlation with intramuscular fat content (Hopkins et al., 2006). Further research in beef has indicated the hydrophobicity of proteins may play a role as denoted by the wavelengths between 1400 – 1500cm-1 (Fowler, Schmidt, van de Ven, & Hopkins, 2018). Consequently, it is hypothesised that loins scored as being more tender by consumers had a greater ability to lose water from the myofibril when chewed, which would have resulted in an enhanced mouth feel during consumption.

Conclusion: Overall, this study demonstrated the potential for Raman spectroscopy to predict eating quality traits of lamb loins. However, further research is needed to establish the characteristics which are underlying predictive models.

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