Variation in Near Infra-red spectra collected from lamb carcases over multiple kills

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I. INTRODUCTION

As lamb carcases in Australia are not cut prior to bone out, there is a limited ability to sort carcases based on meat and eating quality traits. Consequently, there has been much research in the development of rapid, non-invasive tools such as Near Infra-red (NIR) spectroscopy. However, the results of such studies have demonstrated variation between predictive outcomes over multiple data collections [1]. Initial research has demonstrated factors such as pH decline can influence the NIR spectra [2], yet numbers in the study were limited and no other traits were measured. Therefore, a larger study has been conducted to assess the variation in spectra between data collection periods and its relationship with meat quality traits.

II. MATERIALS AND METHODS

At 24 hr post-mortem, the left *M. longissimus lumborum* (LL) was collected from 746 Merino lamb carcases in 7 kills. NIR spectroscopic measurements were conducted using an ASD® TerraSpec4 high resolution spectrometer with the ASD® contact probe [3]. Carcase data and meat quality traits including hot carcase weight (HCW), cold carcase weight (CCW), GR tissue depth, fat over the 5th rib, fat over C site, eye muscle depth (EMD), eye muscle length (EML), pH decline, pH at 24h, temperature at pH6, pH at 18°C, fresh colour, retail display colour, yield, ultimate pH (pHu) and shear force were also measured [4]. Principal Component Analysis was completed on raw spectra and spectra pre-processed via continuum correction and the first 2 scores were saved and regressed against all carcase and meat quality traits. Differences were noted as significant where the P value was <0.05.

III. RESULTS AND DISCUSSION

Although peaks of the spectra were similar between kills, there was a difference observed in the net absorbance of NIR spectra between kills (Fig 1) which was reflected by the PC scores. Consequently, PC scores were clustered based on kill, an effect which was amplified when spectra were pre-processed. Data for two kills (1 and 5) was excluded due to missing data.

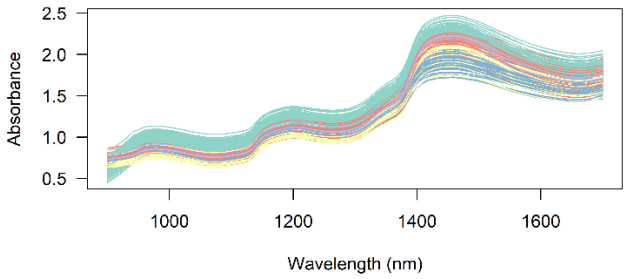
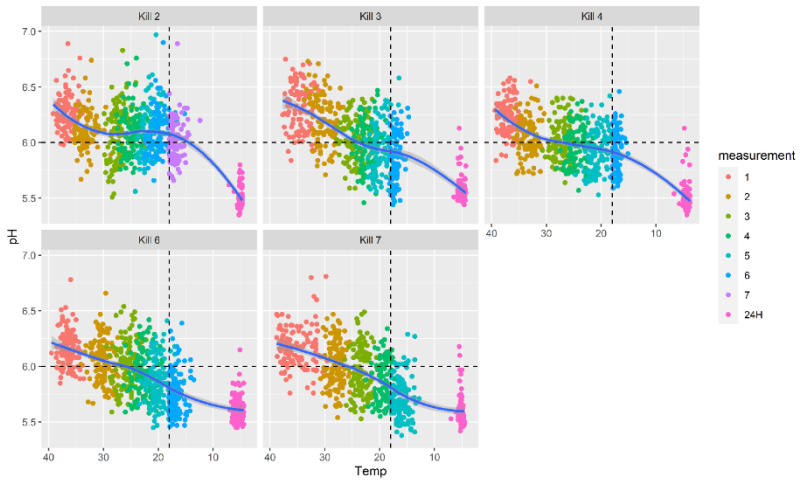


Figure 1. The average NIR spectra for each carcase measured.



Models to assess whether this variation was associated with any meat quality traits demonstrated that HCW, GR tissue depth, rib 5 fat, CCW, EMD, Fat at the C site, pH and temperature measured throughout the pH decline, retail colour traits and yield weights had a significant association with the PC scores 1 and 2 of both the raw and pre-processed spectra.

Figure 2. The pH and temperature decline for each kill.

Given the significance of pH and temperature measures and the indicators of muscularity and fatness which affect chilling rate, this results agree with previous research which suggested metabolic changes and temperature during the early post mortem period affect the NIR spectra [2]. This is supported by the pH decline which varied for kill 2 (Fig 2).

As this study also suggests a link between spectra variation and retail colour, it is hypothesised that the structural and biochemical changes which happen during rigor result in the shrinkage of the myofibril forcing water out of the myofibrillar structure and altering the light properties of the meat [5]. This could account for in the variation in the overall absorbance of the spectra and consequent clustering of PCA scores.

IV. CONCLUSION

This study demonstrated spectral variation is evident between kills and is associated with meat quality and carcase traits. Given many of the traits which were significantly associated are related to the pH/Temp decline, it is hypothesised that metabolic changes which occur during the early post-mortem period have an impact on the overall absorbance of NIR spectra.

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