VARIATION OF MEAT SHEAR FORCE MEASUREMENTS – A CHARACTERISTIC OF MEAT

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Introduction

An objective measurement of tenderness is obtained by determining the force required to shear a cooked standardised piece of meat using a mechanical method of measurement (AMSA, 1995). However, there is wide variation in individual shear force values obtained. The mean values do not always reflect this variation and the variation itself does not follow a normal distribution. These issues have implications when developing non-destructive methods of measuring meat tenderness, such as near infrared spectroscopy (McGlone *et al.*, 2005). Such methods characteristically measure only a portion of the meat and it is important to know whether such measurements are representative or whether a larger series of measurements needs to be obtained to obtain a true representation of the meat being evaluated. The present study investigates the shear force variation from *rigor mortis* until meat is fully aged.

Materials and Methods

Frozen samples of *m. longissimus thoracis et lumborum* (LTL), aged for varying periods, were obtained from 462 sheep. The samples were cooked in a water bath at 85°C until reaching an internal temperature of 75°C and then chilled in ice. Each cooked sample was then cut along the muscle fibre axis using scalpel blades to produce six sub samples (termed bites) with a 1cm x 1cm cross section. All the bites were sheared with a MIRINZ tenderometer with a wedged shaped tooth, as described by Graafhuis *et al.* (1991).

Results and Discussion

To examine the variation between individual readings and mean readings, the first three bites from each sample were plotted against the second three bites from the same sample (Figure 1) and the mean values from each group of three were then plotted against each other (Figure 2). Figure 1 shows that there was a wide scatter between individual readings ($r^2 = 0.7883$) from the same sample. Unsurprisingly, Figure 2 shows that when the means of the first three bites were compared with the means of the second three, the scatter was reduced ($r^2 = 0.9162$). These results suggest that there is a wide variation of individual shear values for each meat sample, but this is obscured when the means are obtained.

The extraordinarily wide variation in shear values for the same piece of meat has not been generally addressed in previous studies, although it is known to occur as the same pattern is indicated with the standard deviations of the mean of each bite. It is known that there is a similar variation between different types of instruments, even on the same pieces of meat (Bekhit *et al.*, 2003) but this variation is also present when the same instrument is used, as in this study.

None of these factors are generally incorporated into tenderness evaluations, as most interpretations are not only focused on mean values, but means of several muscles. For any given piece of meat therefore, the individual shear value variation is masked when the means are compared, but a consumer would note this variation while eating the meat, and therefore it will influence the final perception of the meat quality. Consumers eat larger pieces of meat than are used for tenderometer measurements and make more than one bite on each portion of meat.

The variation may be caused by the measurement device, but his appears unlikely, because the variation reduces at lower shear force values, suggesting it is most likely dominated by the inherent variation of meat, which decreases as ageing progresses. This large variation will have a significant effect on the development of correlations to use near infrared spectroscopy to predict meat tenderness (McGlone *et al.*, 2005).

Conclusions

The results indicate that there is a large range of shear force values with each meat sample that is significantly reduced when these values are averaged. When meat has fully aged the variation is least. While mean values give a good representation of meat that has been fully aged, they do not accurately represent the characteristics of meat that has been insufficiently aged. The importance of this variation with regard to consumer acceptance and when it is used as a basis for the development of new measurement methods should not be underestimated.

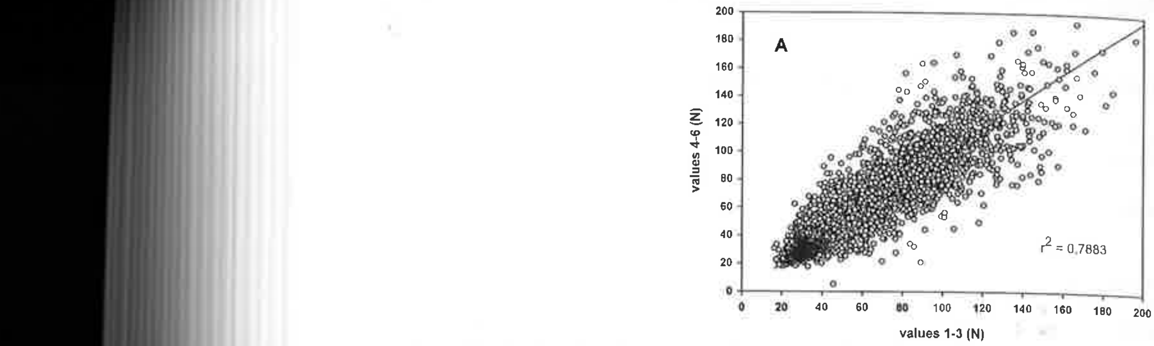

Figure 1: Scatter plot of 2772 shear force values from sheep LTL - Individual readings from the same samples (bites 3 vs. bites 4-6).

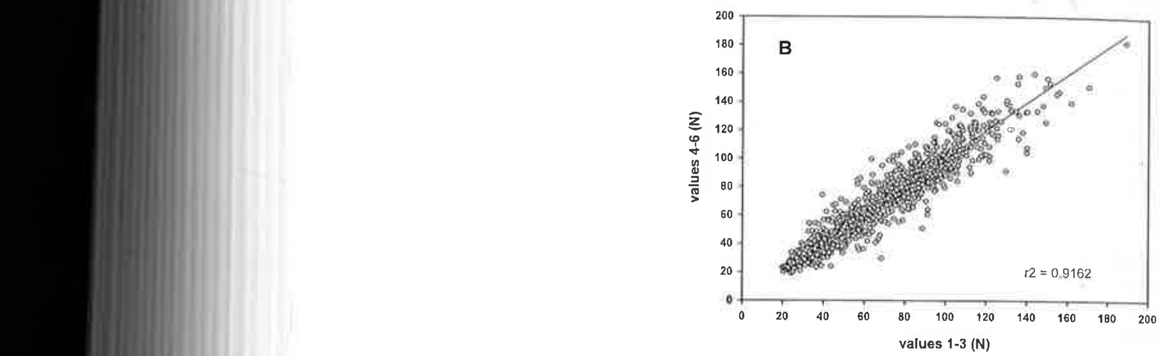

Figure 2: Scatter plot of 924 mean shear force values from sheep LTL - Mean readings from the same samples (mea of bites 1-3 vs. mean of bites 4-6).

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