Consistency Of Tenderness In New Zealand Retail Meat

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Introduction

The planning document for the New Zealand red meat industry, Towards 2000, has identified inconsistency in the tenderness of meat as a major consumer concern. In an earlier survey of meat bought at retail outlets we found a significant proportion was unacceptably tough (Bickerstaffe *et al.*, 1996). This paper describes further research to determine the variation in tenderness and identify some sources of the variation. The ultimate aim of this approach is to develop a vertically integrated system from farm to supermarket that will enable consumers to buy tender meat with confidence.

Objective: To determine the extent and causes of variation in retail beef, lamb and pork.

Methods

Meat samples, along with information on processor, carcase weight and age from slaughter, were supplied by 20 South Island supermarkets to the following specifications. Porterhouse steaks were cut from the mid-loin area and were approximately 30mm thick. Lamb and pork bone-in mid-loin chops were 40mm thick. Typically 5 cuts of each type of meat were supplied by each supermarket. All the meat cuts were packaged separately in labelled plastic bags and frozen.

Prior to tenderness determinations, the samples were partially thawed and a temperature probe inserted into the centre of each muscle before immersion in a 80°C water bath. The samples were cooked to an internal temperature of 75° C, and then cooled in an ice and water mixture. Each sample was cut into 10x10 mm wide strips along the grain of the meat. Each strip was placed in a MIRINZ Tenderometer and the shear force (kgF) to 'bite' across the grain determined (Chrystall and Devine, 1991). An average of 8-10 bites was recorded for different strips cut from the same sample. The sample was considered tender if the shear force required was less that 8kgF, acceptable from 8-11kgF and tough if it required more than 11kgF.

Results

For all three types of meat there was considerable variation in tenderness with a significant proportion of the meat available to the consumer being unacceptably tough (>11kgF). The beef was the most inconsistent (24% unacceptable), followed by the pork (13%) and the lamb (3%).

Table I. Results of survey of retail meat. Shear force (kgF) was determined as described in methods.

Meat	Number of Samples	Mean Shear force (kgF)	Standard deviation	% tough	% acceptable	% tender
Beef	98	8.46	3.95	24	16	60
Lamb	95	5.37	2.38	3	6	91
Pork	88	8.00	2.42	13	26	61

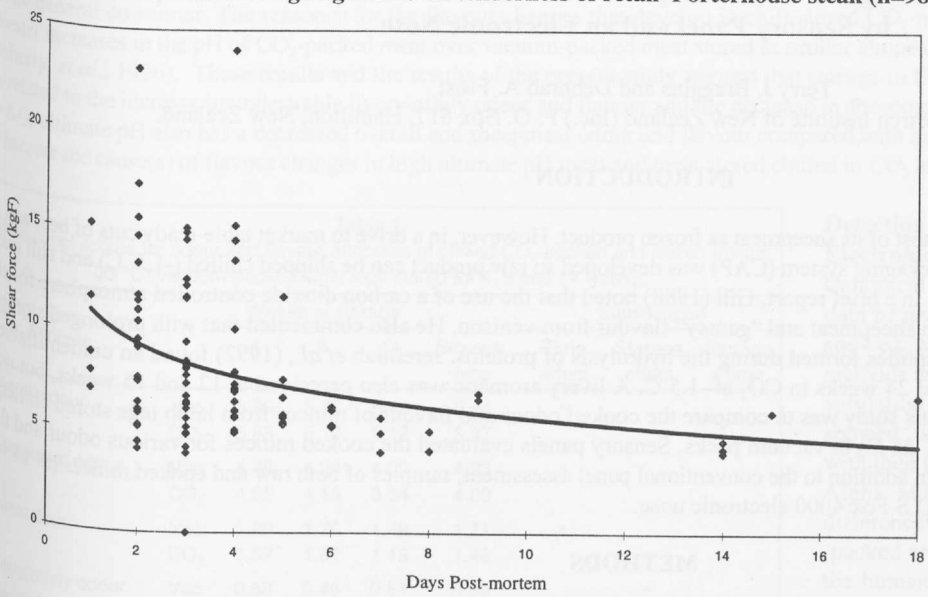
When the results were analysed by supermarket there was wide variation. For example, all of the porterhouse supplied by seven of the twenty supermarkets was tender (< 8kgF). However, in each of the samples from five supermarkets three or more of the steaks were unacceptably tough. Grouping of the tenderness results by supplier also revealed significant variation. For beef (Table II) one of the suppliers (D) provided meat that was on average unacceptably tough whereas all the product from another processor (E) was tender. The four lamb processors analysed showed the same variability with the worst mean shear force (9.14kgF) twice that of the most tender (3.82kgF). The five pork processors were more consistent with mean shear force values from 6.49 to 8.53kgF.

Table II. Variation of Porterhouse steak tenderness with processor. Shear force (kgF) was determined as described in the methods and age refers to the number of days the meat was held at 2°C. Only processors which provided more than 6 samples were analysed.

Processor	Number of Samples	Mean Shear force (kgF)	Std Deviation	Mean age (days)
A	15	7.27	3.21	4.9
B	21	8.12	3.19	3.4
C	10	7.04	1.89	2.6
D	15	11.4	5.57	3.1
E	7	5.2	0.78	3.3

Ageing is known to improve the tenderness of meat. In the analysis of processors there was no obvious relationship with age of the meat. However when all the beef samples were plotted against age (Figure 1), it is clear that the meat became both more tender and more consistent with age. From our data ageing of beef for at least 6 days is required to ensure acceptable shear forces (< 11kgF).

Figure 1. The effect of ageing at 2°C on tenderness of retail Porterhouse steak (n=98).



Meat from export processing plants was also analysed to compare with that supplied to the domestic market (Table III). Lamb, from two processing plants, was measured at 24h post-mortem, the time when it is typically frozen. The lamb was less tender than the domestic meat with two thirds tender (<8kgF) and only 15% unacceptably tough (>11kgF). Results from the two plants were very similar. Beef samples were measured at 24h after slaughter and again at 14 days. This was to simulate the beef that is exported frozen and that which is sent chilled. At 24h nearly half of the cuts were unacceptably tough but ageing for 14 days left all the meat acceptable and 95% of it tender.

Table III. Tenderness of Longissimus dorsi from export processing plants. Shear force was determined as in the methods and those cuts with shear forces above 11kgF were classified as tough and those with shear forces below 8kgF as tender.

Meat	Age (days)	Number of Samples	% tough	% acceptable	% tender
Beef	1	20	45	40	15
Beef	14	20	0	5	95
Lamb (Plant A)	1	105	13	22	65
Lamb (Plant B)	1	81	16	17	67

Discussion

This survey confirmed our earlier research (Bickerstaffe *et al.*, 1996) that a significant proportion of retail beef and pork sold in New Zealand is unacceptably tough. This inconsistency is particularly damaging as tenderness, unlike colour and fat cover, is an attribute that the consumer cannot judge until the meat is eaten. Therefore the consumer ceases to buy red meat.

There are many causes of the variation in tenderness and as shown in this research some of it can be traced back to variation in the suppliers. Removing the inconsistency will require strict quality control of all parts of the chain from "paddock to plate": purchase of quality stock, ensuring the stock reaches the point of slaughter in good condition, control of the processing and ageing at the works, correct treatment of the meat at the retail outlet and consumer education. The beef industries in the United States and Australia are developing these vertically integrated systems and it is also starting in New Zealand with the "Quality" mark for beef and lamb and the "Pquip" programme for pork. Other research by our group is focused on the biochemistry underlying ageing.

Conclusions

1. The tenderness of New Zealand retail meat, particularly beef and pork, is too inconsistent.
2. Some of this variation can be traced to the processing plants.
3. Greater consistency and tenderness could be achieved by increased ageing of the meat.

References

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