THE QUALITY OF AUSTRALIAN BEEF PRODUCED FROM JERSEY AND LIMOUSIN CROSSES

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Background

Variability in consistency of beef and the price compared to other red meats are the most important determinants affecting the purchase of beef by consumers. Unfortunately, consumers differ in their definition of meat quality, complicating the fulfilment of demands for a premium product. Nevertheless, Australia has the genetic and environmental resources to produce large quantities of high quality beef for divergent markets. The aim of this paper is to present some genetic and environmental parameters that influence beef quality in Australian circumstances using Jersey and Limousin crossbred cattle.

Methods

Animals and management. The animals used in this study were part of the Davies Cattle Gene Mapping Herd, ¾ Jersey (XJ) and ¾ Limousin (XL) steers and heifers (Kruk *et al*, 1998). They were born between April/May in 1996 and 1997. The animals born in 1996 comprised 49 females (cohort 96F) and 30 males (cohort 96M), whereas the group born in 1997 consisted of 79 females (cohort 97F). All of the animals were raised on pastures under the same management conditions. They were weaned at 250 days of age and lot fed for 250 days (1996 drop) and 170 days (1997 drop). The animals born in 1996, after completion the lot-feeding, were transported to an abattoir located approximately 500kms from the feedlot and slaughtered on the next day after arrival. Animals born in 1997, after completion the feedlot, were transported 2000km to the abattoir where they were slaughtered after 5 days on a hay diet.

Pre-slaughter and slaughter treatment and measurements. During lot-feeding various phenotypic measurements were taken (live weight, length, height, girth, hip width, stifle width and P8 fat depth) for growth rate and musculature analyses. Blood samples from each animal were collected before transportation to the abattoir for glucose concentration. All carcasses were electrically stimulated using low voltage immediately after stunning. A chiller assessment was performed according to AUS-MEAT specifications. A number of bone and organ measurements were taken while boning out carcasses.

Meat quality assessment. The left side of each carcass was boned out and eye round (*M. semitendinosus*) and strip loin (*M. longissimus dorsi*) samples were collected, cut in 25mm thick steaks, vacuum packed, randomly assigned to different ageing treatment groups (1, 5, 12, 26 days), and frozen after the completion of the ageing treatment. For the purpose of this study, only eye round samples were analysed. Steaks were thawed overnight at 2°C and trimmed to 80-100g samples. pH was recorded prior cooking using a pH, mV, Temp-meter model WP-80. Samples were cooked at 70°C for 40min in a water bath and cooled in running water. Cooking loss was measured by weighing the sample before and after cooking. After overnight in the chiller, rectangular strips (150 x 66mm) were cut parallel to the fibers and Warner-Bratzler shear force measurements were performed according to Bouton et al. (1971).

Statistical analyses. Least squares analysis of variance was carried out using Proc GLM of SAS (SAS 1989). The final model, after removing insignificant interactions, included cohort, breed, sire, and breed by cohort interaction. Least squares means and differences between means were computed. Alphabetical values for meat colour were converted numerically as follows: 1B=1, 1C=1.5, 2C=2.5. Other meat colour scores were 2,3,4,5,6 with higher value being darker. Muscle score was estimated as: stifle width/hip width x 100.

Results and discussion

Animals growth parameters and slaughter performance. There was a significant influence of breed on various parameters related to body dimension (Table 1). Jersey backcross cattle were smaller, shorter and lighter than the Limousin crosses. They also differed in body dimensions, by having smaller girth, narrower hips, stifle, and also less muscle (%). The influence of sire was also significant (Table 1). The progeny of sire 1 were lightest, smallest and had shorter body, whereas sire 2 influenced framework parameters such as girth, hip width and stifle. There was no sire influence on musculature. Sex differences could be compared between heifers and steers born in 1996, as they did not differ in age and were lot fed for the same number of days. As expected, steers were bigger and heavier as indicated by live weight, height, length and girth. Interestingly, there was no difference in stifle and hip width between the sexes and no difference in muscle score. Average daily gain during the last 28 days before slaughter varied between cohorts and was the highest in steers born in 1996 (995g/day), followed by heifers born in 1996 (634g/day), and heifers born in 1997 (465g/day).

A similar influence of breed, sex and sire was observed in carcass traits. The lighter carcasses were produced by females, Jersey crosses and Sire 1. Males and Limousin cattle produced the longest carcasses. Eye muscle area (EMA) was significantly larger in Limousin crosses and in males. Sire 1's progeny again were characterized by the smallest EMA. P8 fat depth was higher in females with no significant differences between breeds or sires.

Meat Quality. Animals fed on high grain diets for a longer time had higher marbling regardless of sex. However, breeds varied in marbling with Jersey crosses having higher values. Fat colour score was also higher in Jersey crosses and highest in Sire 1 progeny. This difference just missed statistical significance (P<0.086).

Table 1. Least square means (±) for growth parameters, carcass traits and meat quality

Trait	Cohort			Sire			Breed	
	96F	96M	97F	Sire 2	Sire 3	Sire 1	XJ	XL
Growth performance								
Live weight (kg)	623.3±7.8	678.8±10.3	578±6.7	629.4±8.2	641.8±8.0	609.8±8.0	573.1±7.0	680.9±6.8
Length (cm)	145.8±1.0	157.2±1.3	146.7±0.8	149.6±1.0	152.9±1.0	147.2±1.0	147.5±0.9	152.4±0.8
Height (cm)	132.7±0.5	140.6±0.7	130.4±0.6	135.0±0.6	135.9±0.5	132.8±0.5	130.6±0.5	138.5±0.5
Girth (cm)	216.4±1.1	221.2±1.5	216.2±0.9	220.5±1.2	217.1±1.1	216.2±1.1	212.6±1.0	223.3±1.0
Muscle score	85.6±0.7	85.3±1.0	74.1±0.6	81.4±0.8	81.9±0.8	81.8±0.8	75.7±0.7	87.7±0.7
Carcass traits								
HSCW (kg)	346.6±5.8	373.9±7.6	302.7±5.0	336.6±6.1	354.6±6.0	332.0±5.9	303.2±5.2	379.0±5.1
Carcass length (cm)	136.3±0.6	139.0±0.8	135.7±0.5	136.2±0.6	137.5±0.6	136.4±0.6	135.3±0.5	138.1±0.5
P8 fat depth (mm)	16.8±0.7	11.6±0.9	10.9±0.6	13.3±0.7	12.6±0.7	13.4±0.7	13.5±0.6	12.7±0.6
Eye muscle area (cm^2)	83.3±1.5	81.6±2.0	71.5±1.3	79.7±1.6	81.4±1.6	75.4±1.6	70.9±1.4	86.7±1.3
Meat quality								
Marbling score	1.98±0.10	2.09±0.13	1.10±0.08	1.75±0.10	1.69±0.10	1.73±0.10	2.04±0.09	1.40±0.08
Fat colour score	0.86±0.12	0.62±0.16	0.70±0.11	0.73±0.13	0.57±0.13	0.89±0.13	1.04±0.11	0.41±0.11
Meat colour score	1.05±0.08	1.03±0.11	1.65±0.07	1.40±0.09	1.07±0.09	1.26±0.09	1.33±0.08	1.16±0.07
WB1 (kg)	4.6±0.1	4.4±0.1	5.6±0.1	5.0±0.1	4.8±0.1	4.8±0.1	5.2±0.1	4.6±0.1
WB5 (kg)	4.3±0.1	4.1±0.1	5.2±0.1	4.5±0.1	4.6±0.1	4.5±0.1	4.8±0.1	4.2±0.1
WB12 (kg)	4.1±0.1	3.9±0.1	5.0±0.1	4.4±0.1	4.3±0.1	4.3±0.1	4.7±0.1	4.0±0.1
WB26 (kg)	3.9±0.1	3.8±0.1	4.9±0.1	4.3±0.1	4.1±0.1	4.1±0.1	4.5±0.1	3.9±0.1
pH 1	5.71±0.02	5.72±0.03	5.63±0.02	5.68±0.02	5.70±0.02	5.69±0.02	5.70±0.02	5.68±0.02
pH 5	5.62±0.02	5.63±0.02	5.68±0.01	5.65±0.02	5.64±0.02	5.63±0.02	5.65±0.02	5.63±0.02
pH 12	5.73±0.02	5.75±0.02	5.75±0.01	5.74±0.02	5.74±0.02	5.74±0.02	5.75±0.02	5.73±0.02
pH 26	5.70±0.02	5.74±0.02	5.83±0.02	5.75±0.02	5.76±0.02	5.75±0.02	5.75±0.02	5.76±0.02
Cook loss (%)	24.8±0.3	24.2±0.4	27.6±0.2	25.4±0.3	25.5±0.3	25.7±0.3	25.6±0.2	25.5±0.2

Note: WB-Warner-Bratzler shear force, numbers from 1-26 next to WB and pH signify the number of days for ageing treatment, HSCW-hot carcass weight

The darkest meat was observed in females born in 1997. Sire 2's progeny had significantly darker meat than Sire 1 and 3. On average, there was no difference in pH between cohorts, sires and breeds. However, when assigned to different treatment groups from day 5-26, heifers born in 1997 had significantly higher pH. Moreover, 14% of heifers had pH ≥5.9 compared to 2.6% in cohort 96F and 1.7% in 96M. Males and females born in 1996 produced very tender meat (WB shear force<5kg) with no difference between sexes. Females 1997 had significantly tougher meat, which even after 26 days of ageing more than half of the samples would be regarded as tough by Western consumer panels.

Breed and sire effects on phenotypic measurements and carcass traits including Jersey and Limousin crosses have been reported in our other studies (Pitchford and Bottema, 2000). However, the variation in meat quality demonstrates that crossbreeding of Jersey and Limousin cattle also results in an enhanced meat quality required in highly priced markets. The decreased carcass dimension in Jersey crosses, can be compensated by the increased marbling, a major selection criterion on Japanese market. However, caution has to be taken as Jersey crosses can have yellower fat, which is undesirable in Japan. On the other hand, Limousin cattle are regarded as a very lean breed, which do not always fulfill the requirements of the domestic market. Crossbreeding Limousin with Jersey cattle enhanced marbling/fatness and produced tender meat with white fat essential for Australian consumers. In Australia, cattle are usually raised extensively at pasture and then finished in feedlots. This very often requires transportation of animals for long distances. Such stress influences meat quality (Ferguson, 2000). Heifers born in 1997 were trucked 2000kms within 24 hours, which probably was the major factor influencing the higher percentage of carcasses with darker meat, increased cooking loss and decreased tenderness. Ageing of meat can be an option for improvement of tenderness. However, it is not always effective and if applied for an extended period, is also expensive.

Conclusions

Crossbreeding of Jersey and Limousin cattle resulted in an enhanced carcasses quality that could fulfill satisfactorily Australian domestic and overseas markets. However, a large sire influence on many traits requires an appropriate sire selection. Various factors between the pasture and plate of a consumer have an impact on eating experience. The identification and control of these factors assure the high quality of beef. Australia, with its large genetic and environmental resources, disease free status and newly implemented Meat Standards Australia (MSA) grading system has a potential to produce high quality beef satisfying even the most demanding consumers.

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