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BRIEF COMMUNICATION: Quality of meat from steers born to beef-cross-dairy cows and sired by Hereford bulls

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Introduction

The dairy industry is playing an increasing role in beef production in New Zealand. It is estimated that 65% of the beef produced in New Zealand originates from dairy herds in the form of Friesian bull beef, first-cross dairy-beef cattle, or cull cows (Morris 2008). The dairy herd has a role in the generation of beef-cross-dairy breed heifers that are used as beef breeding cows. Dairy cattle genetics are not orientated towards meat production and this raises the question as to the suitability of beef-cross-dairy breed cows for producing progeny that are slaughtered for meat production. The quality of meat from the progeny of first-cross dairy-beef cows is largely unknown.

The main dairy breed used in New Zealand is the Holstein-Friesian and the Jersey breed is also very predominant. To take advantage of hybrid vigour, the Friesian-Jersey cross is commonplace in the New Zealand dairy herd. The Friesian-Jersey cross is now considered as a breed in itself and called the "Kiwi-cross" or "Kiwi" breed (Garrick & Lopez-Villalobos, 1998). Therefore, the objective of this study was to compare the quality of meat from steers which had an Angus (AA), Angus-cross-Friesian (AF), Angus-cross-Kiwi (AK) or Angus-cross-Jersey (AJ) dam. The steers were sired by Hereford bulls and so, the straight-bred Angus dams (AA) provided steers with beef-only genetics for comparison.

Materials and methods

Seventy-eight crossbred steers were used in this experiment. The steers were born in spring 2010 and sired by a straightbred Hereford (HH) bull. Dams were primiparous, two-year-old cows of the following breed: straightbred Angus (AA; n=25), Angus cross Friesian (AF; n=21), Angus cross Kiwi-cross (AK; n=11) and Angus cross Jersey (AJ; n=21).

The steers were grazed on pasture under commercial farming conditions. The calves-at-foot and the weaned steers were managed in a single group at Massey University's Tuapaka farm near Palmerston North until May 2012. The target for slaughter was a 300 kg carcass weight (600 kg live weight). Some steers grew faster and reached this target sooner, so the animals were slaughtered in two lots, one in May 2012 (n=38) and the other in November 2012 (n=40). Slaughter lots were balanced for breed. Following the May slaughter, the remaining steers were moved to Massey University's Riverside farm near Masterton where they grazed until slaughter in November. Prior to being transported to the abattoir the steers were weighed on-farm, directly off feed, to get a final live weight.

Steers were slaughtered at Land Meat New Zealand Ltd in Wanganui (May 2012) and AFFCO New Zealand LTD in Feilding (November 2012). Commercial dressing procedures were followed and a hot carcass weight was obtained. After overnight chilling (24 hours post-mortem) a tracing was made of the *longissimus* muscle from the right side of the carcass at a transverse cut between the 12 and 13 ribs (eye muscle area; EMA). The tracing area was subsequently measured using a planimeter (Placom KP-90N, Tokyo, Japan). The fat thickness over the *longissimus* muscle at the same site between ribs 12 and 13 was also measured (fat depth C). From the caudal end of the striploin a sample of approximately 1 kg was obtained and transported to Massey University where it was chilled at 1°C for 7 days and then frozen (-20°C) until meat quality tests were carried out.

The pH of the striploin that was defrosted over 12 hours at 4°C was measured by pH spear (Eutech Instruments, Singapore). A fresh slice of the striploin was made (with subcutaneous fat left on) and after 30-min exposure to air the muscle and fat lightness (L*), redness (a*) and yellowness (b*) was measured using a Minolta CR-200 chromameter. Tenderness was assessed by the peak force required to shear 13 mm-square cores from loin steaks cooked in a water bath at 70°C for 90 min (Warner-Bratzler device, square blade). The average peak force of 12 shears from each sample was calculated. A 100 g sample of the striploin, trimmed of subcutaneous fat was minced and used for the measurement of intramuscular fat and for fatty-acid analysis. The percentage of intramuscular fat in the loin was measured using a Soxhelet extraction procedure with petroleum ether solvent (AOAC 911.36) and fatty acids were quantified by gas-liquid chromatography (Shimadzu GC-17A) based on the methodology of Sukhija and Palmquist (1988).

The growth performance, meat quality, intramuscular fat percentage and fatty acids measurements were analysed using general linear models (PROC GLM, SAS) with breed as the fixed effect and carcass weight as a covariate for the intramuscular fat percentage and fatty acid statistical analysis. Slaughter date was used as a covariate in all statistical analyses. However, the results were not affected by slaughter date and so it was removed from the statistical model.

Results and discussion

Growth performance

The steers from the Angus-cross-Friesian dams had the highest mean final live weight (P <0.001; Table 1) and this translated into the highest carcass weight (P <0.001; Table 1). A higher dressing-out percentage was observed with the steers from straight-bred Angus dams compared to the steers from Angus-cross-Jersey dams (P =0.001; Table 1). The Friesian breed has a higher mature body weight compared to the Jersey and Kiwicross breeds. A higher mature weight drives faster growths rates and is the likely explanation for the higher final live weight and carcass weight of the steers from the Angus-cross-Friesian dams.

There was no difference in the eye-muscle area and fat depth for the steers from the different dam breeds (Table 1) indicating that the steers had a similar muscle and fat deposition.

Meat quality

There was a tendency for the lean meat from steers born to Angus-cross-Jersey dams to be redder (P =0.066; Table 2) but the difference was small and unlikely to be detected by purchasers of beef. Overall, the ultimate pH, meat and fat colour parameters and the Warner-Bratzler shear force were the same for the different breeds (Table 2). This indicates that the consumers will be unlikely to differentiate beef as coming from steers that have dairy-based breeds in their genetic profile compared to those that have straight beef genetics.

The ultimate pH is a driver of some meat quality characteristics (Purchas & Aungsupakorn 1993). The similarity in meat quality for beef from the different breeds is likely to be partially a consequence of no difference in the ultimate pH. Previous studies have also considered the breed of cattle to be a poor contributor to variation in beef quality parameters and unlikely to create large differences in beef quality when the cattle breeds are grown to slaughter under similar conditions (Purchas & Barton 1976; Burke et al. 1998; Viera et al. 2007; McGregor et al. 2012).

Intramuscular fat % and fatty acids

The fatty acid composition of meat is an indicator of nutritional value for humans (Wood et al. 2003). Nutritional value is determined by the ratio between saturated and unsaturated fatty acids. There was a tendency for the lean meat from steers born to Angus-cross-Friesian dams to have a higher concentration of polyunsaturated fatty acids including the omega-3 fatty acids (P =0.07) however, this did not translate to a difference in the polyunsaturated-to-saturated ratio (Table 2). A polyunsaturated-to-saturated ratio above 0.45 is considered the lowest risk for cardiovascular disease (Simopoulos 2004) however, none of the breeds in this study were able to provide a ratio greater than 0.45 with the highest average polyunsaturated-to-saturated ratio observed in this study being 0.13.

Another indicator of nutritional value is the ratio of omega-6 to omega-3 fatty acids in the meat. There was no difference among the breeds for the long-chain omega-3 polyunsaturated fatty acids although the steers born to Angus and Angus-cross-Kiwicross dams had a lower omega-6:omega-3 fatty-acid ratio as a consequence of these breed having a lower concentration of the omega-6 fatty acid, gamma-linolenic acid (P =0.006; Table 2). The meat with the lower omega-6:omega-3 fatty-acid ratio could be considered as being of higher nutritional value for human consumption but, the ratio in the meat from all breeds was below 4:1. At a ratio above 4:1 the risk of cardiovascular disease and cancer increases (Simopoulos 2004).

Conjugated linoleic acids (CLA) are considered to reduce the risk of some cancers and cardiovascular disease (Wood et al. 2003). The CLA was not measured in this study however, there is a strong relationship between trans-vaccenic acid and CLA because CLA is synthesised from trans-vaccenic acid by the enzyme delta-9 desaturase (Warren et al. 2008).

Table 1: Final live weight measured on-farm and carcass weight, eye muscle area and fat depth over the eye muscle (fat depth C) for steers with either Angus (AA), Angus-cross-Friesian (AF), Angus-cross-Kiwicross (AK) and Angus-cross-Jersey (AJ) dams and sired by a Hereford (H) bull. Bold type indicates significance at P <0.05.

	H-AA	H-AF	H-AK	H-AJ	P-value
n	25	21	11	21	
Final liveweight (kg)	594.9 ± 7.1^{b}	623.3 ± 7.6^{a}	587.9 ± 9.4^{b}	587.9 ± 7.5^{b}	**<0.001**
Carcass weight (kg)	301.8 ± 3.9^{b}	312.9 ± 4.2^{a}	291.5 ± 5.2^{bc}	290.2 ± 4.1^{c}	**<0.001**
Dressing-out (%)	50.7 ± 0.3^{a}	50.2 ± 0.3^{ab}	49.6 ± 0.4^{bc}	49.4 ± 0.3^{c}	**0.001**
Eye muscle area (cm^2)	70.7 ± 2.2	73.0 ± 2.3	67.8 ± 3.2	73.6 ± 2.4	0.406
Fat depth C (mm)	5.4 ± 0.5	5.1 ± 0.5	5.4 ± 0.8	6.0 ± 0.6	0.658

Values within rows that contain the same letter in their superscripts are not significantly different (P >0.05).

Table 2: Meat quality, intramuscular fat percentage and fatty acid proportion (mean ± standard error of the mean) of the striploin meat from steers with either Angus (AA), Angus-cross-Friesian (AF), Angus-cross-Kiwicross (AK) and Angus-cross-Jersey (AJ) dams and sired by a Hereford (H) bull. Bold type indicates significance at P <0.05.

	H-AA	H-AF	H-AK	H-AJ	P-value
n	25	21	11	21	
Ultimate pH	5.73 ± 0.02	5.75 ± 0.02	5.74 ± 0.03	5.70 ± 0.02	0.299
Shear force (kgF)	9.23 ± 0.49	9.13 ± 0.53	9.74 ± 0.75	9.76 ± 0.53	0.787
Lean meat colour:					
- Lightness (L*)	38.8 ± 0.4	37.7 ± 0.5	38.4 ± 0.7	38.2 ± 0.5	0.850
- Redness (a*)	14.2 ± 0.3	13.4 ± 0.3	13.6 ± 0.5	14.4 ± 0.3	0.066
- Yellowness (b*)	4.2 ± 0.2	3.8 ± 0.2	3.7 ± 0.3	4.2 ± 0.2	0.168
Fat colour:					
- Lightness (L*)	69.7 ± 0.5	69.0 ± 0.5	70.2 ± 0.7	68.9 ± 0.5	0.384
- Redness (a*)	5.00 ± 0.3	5.30 ± 0.3	4.68 ± 0.5	5.1 ± 0.3	0.746
- Yellowness (b*)	6.59 ± 0.5	6.92 ± 0.6	6.41 ± 0.8	7.72 ± 0.6	0.428
Intramuscular fat (% of meat)	3.55 ± 0.21	3.52 ± 0.23	3.77 ± 0.30	3.89 ± 0.23	0.542
Fatty Acids (% of total fatty acids):					
- Saturated (SFA)	48.8 ± 0.5	48.6 ± 0.5	49.3 ± 0.5	47.8 ± 0.5	0.248
- Monounsaturated	45.9 ± 0.5	45.2 ± 0.5	45.1 ± 0.5	47.2 ± 0.5	0.078
- Polyunsaturated (PUFA)	5.3 ± 0.3	6.2 ± 0.3	5.6 ± 0.3	5.0 ± 0.3	0.063
- *trans*-Vaccenic	1.81 ± 0.07	1.78 ± 0.07	1.75 ± 0.07	1.67 ± 0.07	0.558
- Eicosapentaenoic (EPA; *n*-3)	0.57 ± 0.05	0.70 ± 0.05	0.64 ± 0.05	0.52 ± 0.05	0.068
- Docosapentaenoic (DPA; *n*-3)	0.61 ± 0.04	0.71 ± 0.04	0.61 ± 0.04	0.54 ± 0.04	0.069
- Docosahexaenoic (DHA; *n*-3)	0.08 ± 0.02	0.11 ± 0.02	0.12 ± 0.02	0.10± 0.02	0.573
- PUFA:SFA	0.11 ± 0.01	0.13 ± 0.01	0.12 ± 0.01	0.11 ± 0.01	0.097
- *n*-6:*n*-3	1.11 ± 0.02^{a}	1.18 ± 0.02^{b}	1.13 ± 0.02^{a}	1.19 ± 0.02^{b}	**0.006**

Values within rows that contain the same letter in their superscripts are not significantly different (P >0.05).

There was no difference in the trans-vaccenic acid proportion between breeds indicating that the CLA content of the meat between the dairy-beef cross breeds is unlikely to be different.

Conclusion

Overall, there was very little difference in the quality or nutritional value of the meat from steers from different beef-cross-dairy breed cows used in this study. Therefore, the eating quality of beef is not likely to be impacted by using dairy-cross breed cows for beef production. The main concern is likely to be the growth performance and carcass yields and this needs further consideration in terms of assessing the efficiency of using beef-cross-dairy breed cows for beef production.

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