Growth and meat quality of Holstein and Fleckvieh X Holstein bull calves

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Abstract

In South Africa meat from cattle is classified as veal when no molar teeth have erupted yet or the carcass weight is below 100 kg. In South Africa this is a small niche market not yet fully exploited. Little research has been done on the quality of veal locally. Furthermore little information is available on the effect of the quality of veal resulting from crossbreeding dairy cows with beef breeds to increase beef production of a dairy herd. This study details slaughter and carcass traits of 14 Holstein and 14 Fleckvieh X Holstein bull calves. Slaughter weight, cold carcass weight and dressing percentage of carcasses were determined. Fat depth was measured at two sites, i.e. 25 mm from the midline at the 13th rib and between the 3rd and 4th lumbar vertebrae. The pH of the meat was measured 45 minutes (pH_{45}) and 48 hours post mortem (pH_u). The *Longissimus dorsi* (11-13th rib) muscle was used for meat quality characteristics: drip loss, colour, cooking loss and shear value. The calves were slaughtered at the same live weight and no differences in slaughter age (141 vs. 143 days), carcass weight and dressing percentage (51.3 vs. 51.1 %) were found between Holstein and Fleckvieh X Holstein calves. Fat depth measured at two sites did not differ between breeds. Initial pH of the meat from purebred Holstein calves was lower than meat from Fleckvieh X Holstein calves (6.49 vs. 6.66). No differences were found in the other meat characteristics. The performance of crossbred calves was similar to that of purebred calves in terms of growth. Crossbreeding Holstein cows with Fleckvieh bulls had no detrimental effects on any of the meat quality characteristics measured.

Introduction

Because the milk yield of dairy cows provides the major source of income for dairy farmers they have in the past concentrated on optimising the milk yield of dairy cows. This has led to a reduction in fertility in dairy cows (Van Raden, *et al*., 2003). One way to overcome this is by crossbreeding with another breed to utilize hybrid vigour, on the assumption that the breed selected for crossbreeding provides the required complementary traits and that the genetic distance between the breeds to be used is relatively wide (Pyman, 2006). With most crosses currently tested, the heterosis for survival was approximately 5% above the mid-parent mean (Carrick, et al., 2003). Currently in South Africa, little data is available of which crosses provide the best combination. By using a dual purpose breed such as the Fleckvieh, a Simmentaler derived breed from Germany, milk yield and milk composition of dairy breeds are not compromised while improving the fertility and beef quality characteristics of dairy breeds. Because the Simmentaler breed is relatively abundant in South Africa many dairy farmers have started crossbreeding Holstein cows with Fleckvieh sires.

Little effort has been put into the rearing of bull calves because that does not always show a profit especially when viewed as a separate enterprise within the dairy industry. But using crossbreeding in a dairy herd a small niche market in producing veal, specifically read veal, could be exploited. In South Africa meat from cattle is classified as veal when no molar teeth have been erupted yet or the carcass mass is below 100 kg (Slabbert, 2007). Little information is available on the veal quality from these different crosses.

Materials and methods

The study was conducted at the Elsenburg Research Station of the Western Cape Department of Agriculture. Elsenburg is situated approximately 50 km east of Cape Town in the winter rainfall region of South Africa. Purebred Holstein and Fleckvieh X Holstein bull calves were sourced from a commercial dairy herd within five days after birth. Calves were transported to Elsenburg and put into individual pens. Birth dates and live weight on arrival was recorded for each calf. Colostrum was fed to the calves from calving until five days of age. On arrival they received preheated colostrum collected from cows that had calved in the Elsenburg herd. Calves received colostrum up to eight days of age and thereafter full cream milk at 5% of body weight twice a day until weaning at six weeks of age. A calf starter meal containing 18% crude protein (CP) was provided *ad libitum* from seven days of age until two months of age. From two months of age, a growth meal containing 15% CP was provided *ad libitum* until slaughter at about five months of age.

At three months of age, the bull calves were dehorned and castrated using a Burdizzo. The calves were weighted monthly until slaughter weight was reach to produce a carcass of less than 100 kg.

Full body live weight was determined 24 hours prior to slaughtering. The calves were slaughtered at a commercial abattoir using standard South African slaughter techniques, which included stunning with a pen pistol before being exsanguinated. Carcasses were subsequently hung to bleed out after which they were skinned. Measurements on the carcass included the measurement of the fat depth at two sites, i.e. at the 13th rib 25 mm from the midline and between the 3rd and 4th lumbar vertebrae 25 mm from the midline on the left side of the carcass.

After 48 hours in cold storage (4°C), the carcasses were weighed to determine cold carcass weight. Instrumental measurements of meat quality were made on the *M. longissimus lumborum*. A CRISON pH meter (507) was inserted directly into the meat, to measure pH 45 min and 48 h post mortem. The pH was measured on the right side of each animal in the *M. longissimus* between the 1st and the 2nd lumbar vertebrae. The *M. longissimus dorsi* muscle from the left side was dissected from the 1st to the 6th lumbar vertebrae and used for meat quality analyses (Schönfeldt *et al*., 1993). These meat quality analyses included the following: cooking loss, drip loss, colour and meat tenderness. Tenderness of the meat (the same sample as used for cooking loss) was measured with the Warner-Bratzler shear force test using 1.27 cm diameter samples in triplicate (Honikel, 1998). Maximum shear force values (N) required to shear a cylindrical core, perpendicular to the grain (at a crosshead speed of 200.0 mm/min), were recorded for each sample and the mean was calculated for each muscle. The ASREML statistical package (Gilmour *et al*., 1999) was used to analyze the data.

Results and discussion

The slaughter weight of calves did not differ (P>0.05) as the target was to produce a carcass of less than 100 kg. Calves of the two breeds reached this target slaughter weight at the same age (Table 1), indicating no difference in the growth rate between the two breeds. Dressing percentage and cold carcass weight did not differ (P>0.05) between the two breeds. The fat depth measured at the two different sites also did not differ (P>0.05) between the two breeds. It seems that the deposition of subcutaneous fat had not started at the age calves were slaughtered (Lawrie, 1998).

Table 1. The means (± SE) of growth and carcass characteristics from Holstein and Fleckvieh X Holstein bull calves reared under the same conditions

Trait	Holstein	Fleckvieh X Holstein	Significance
Number	14	14	
Slaughter age (days)	141 ± 3	143 ± 2	ns
Slaughter weight (kg)	188.9 ± 2.3	187.9 ± 3.4	ns
Cold carcass weight (kg)	96.9 ± 1.3	95.5 ± 1.5	ns
Fat depth 13th rib (mm)	0.36 ± 0.02	0.39 ± 0.03	ns
Fat depth 3rd/4th lumbar (mm)	0.26 ± 0.05	0.36 ± 0.05	ns
pH_{45}	6.49 ± 0.10	6.66 ± 0.12	*
pH_u	5.38 ± 0.10	5.30 ± 0.10	ns
Cooking loss %	30.2 ± 1.1	30.4 ± 1.3	ns
Drip loss %	1.40 ± 0.04	1.48 ± 0.05	ns
Colour L*	41.3 ± 0.5	41.9 ± 0.6	ns
A*	9.52 ± 0.3	9.79 ± 0.4	ns
B*	9.28 ± 0.4	8.83 ± 0.3	ns
Shear value (N)	39.4 ± 4.1	42.9 ± 5.2	ns

* = Significant (P<0.05)   n.s. = Not Significant

Initial pH measured 45 minutes after slaughter in the *M. longissimus dorsi* muscle of purebred Holstein bull calves was lower (P<0.05) than that of Fleckvieh X Holstein calves. The higher pH_{45} value of Fleckvieh X Holstein suggested that they might have experienced lower stress levels immediately prior to slaughter. The post-mortem pH is determined by the amount of lactic acid produced from glycogen during anaerobic glycolysis. This is curtailed if glycogen is depleted by fatigue or fear in the animal before slaughter resulting in a lower initial pH (Lawrie, 1998). This contention however could not be validated, since no measures of stress were recorded while the animals were slaughtered at random. Other meat characteristics also did not differ (P>0.05) between breeds.

Conclusions

The growth rate of Fleckvieh x Holstein and Holstein bull calves was similar up to slaughter at about 5 months of age. Post-portem pH levels indicate that purebred calves may be more susceptible to stress than crossbred calves. Crossbreeding Holstein cows with Fleckvieh sires had no detrimental effects on any of the meat quality characteristics measured.

References

Carrick, M., Bowman, P.J., Goddard, M., 2003. Improving herd fertility and survival in the herd using ADHIS and Herd Recording data. Final Report to Dairy Herd Improvement Fund, June 2003, 1-63.

Gilmour, A.R., Cullis, B.R., Welham, S.J., Thompson, R., 1999. ASREML – Reference manual. NSW Agricultural Biometric Bulletin No. 3. NSW Agriculture, Orange Agricultural Institute, Forest Road, Orange 2800, NSW, Australia.

Honikel, K.O., 1998. Reference methods for the assessment of physical characteristics of meat. Meat Sci. 49, 447-457.

Lawrie, R.A., 1998. Lawrie's Meat Science. 6th ed. Woodhead Publ. Ltd. Cambridge, England.

Pyman, M.F., 2006. Dairy crossbreeding to improve health and reproduction performance. Animal production and Animal Science Worldwide. WAAP book of the year 2006. Eds. A. Rosati, A. Tewolde and C. Masconi. Wageningen Academic Publishers. Wageningen.

Schönfeldt, H.C., Naudè, R.T., Bok, W., Van Heerden, S.M., Smit, R., 1993. Flavour- and tenderness-related quality characteristics of goat and sheep meat. Meat Sci. (34) 363-379.

Slabbert, K., 2007. Veal – the new deal. The Dairy Mail, 14 (6): 65-67.

Van Raden, P., Sanders, A., Tooker, M., Miller, R., Norman, D., 2003. Daughter pregnancy rate evaluation of cow fertility. Online available http://aipl.arsusda.gov/reference/fertility/DPR_rpt.htm.