# BRIEF COMMUNICATION: Meat quality of light-weight, yearling steers of dairy origin

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## Abstract

Approximately 2 million surplus calves are produced annually by the dairy industry, and are commonly processed at around one week of age as "bobby" calves. There is an opportunity to utilise these calves in a novel beef-production system with a slaughter age between eight and twelve months of age. The objective of this study was to compare objective meat-quality attributes of Hereford x Friesian-Jersey steers slaughtered at eight, ten and twelve months of age, while trying to maximise growth rates. The *M. Longissimus lumborum* (striploin) had a lower shear force at 10 months old (4.6±0.3kgF) compared to eight and 12 months old (5.1±0.3 and 5.6±0.3kgF) ($P<0.05$), although the absolute differences were numerically small. Meat colour became darker as animals became older ($P<0.05$). The differences in meat-quality from steers grown under conditions designed to maximise growth rates and slaughtered between eight and twelve months of age were small, suggesting that meat from all these age groups could be processed under one classification.

**Keywords:** beef; dairy; steers; carcass characteristics; meat-quality; age

## Introduction

New Zealand's dairy sector potentially faces scrutiny for its practice of slaughtering bobby calves. Concerns surrounding animal welfare present a risk to the industry's social licence to farm and to consumer acceptability. New Zealand currently processes approximately 2 million calves within two weeks of birth, and another group of calves (estimated to be around 500,000) are euthanised on-farm as a means of disposal (Jolly, 2016). These calves are typically bull and heifer calves born to low-genetic merit parents that are not suitable as dairy replacements, or from unwanted breed crosses such as Jersey crosses. A "zero-bobby" policy would require alternative end-points for surplus dairy calves. Friesian-Jersey and Jersey calves currently have limited use in beef production and feature heavily in the bobby-calf kill. These calves provide a potential source of animals for a newly proposed beef-production system in which cattle are slaughtered at approximately one year of age. The objective of this study was to compare meat-quality attributes of Hereford x Friesian-Jersey steers grown under conditions designed to maximise growth rates and slaughtered at eight, ten and twelve months of age, in order to understand the type of meat product that could be sourced from yearling cattle from the dairy industry.

## Materials and methods

Sixty Hereford x Friesian-Jersey weaner steer calves born in spring 2017 were sourced from a commercial calf rearer at three months of age (average 103±1kg live weight). The calves were managed as a single group, however, they were randomly pre-assigned at eight months of age to one of three slaughter treatments of eight, ten and twelve months of age, with each treatment group balanced for live weight at eight months of age. Steers were grazed on plantain (*Plantago lanceolata*), chicory (*Cichorium intybus*), white clover (*Trifolium repens*) and red clover (*Trifolium pratense)* herb-clover between December and January, and supplemented with Sharpes Earlywean meal at approximately 0.5kg/head/day. During February, steers were grazed on a Hunter brassica crop. From March until slaughter, steers were then grazed on ryegrass and white clover pasture. Feeding levels were maintained to achieve a target live weight gain of 1.0kg/day. Calves were weighed unfasted fortnightly and prior to transport to the abattoir.

Steers were slaughtered and processed in May, July and September 2018 at eight, ten and twelve months of age respectively, at Venison Packers Feilding Ltd. Standard commercial dressing procedures were followed and a hot carcass weight was obtained at the abattoir. The dressed carcasses were hung in a chiller overnight at 4ºC and boned the following day into commercial cuts. The cranial end of the *M. Longissimus lumborum* (striploin) from the left side of the carcass was vacuum packed 24 hours post-mortem and stored at -20°C until meat-quality analysis.

Striploin samples were defrosted for 24 hours at 1ºC prior to meat-quality analysis. Ultimate pH was measured using a pH spear (Eutech Instruments, Singapore) at three points across the striploin. The transverse surface cut of a striploin steak was exposed to air for 30 minutes and subsequently, lightness ($L^*$), redness ($a^*$) and yellowness ($b^*$) were measured using a Minolta CR-200 chromameter. A 25mm thick striploin steak was cooked in a water bath at 70°C for 90 minutes and used to obtain 13mm diameter cylindrical cores. The average peak force required to shear through six cores was measured (Warner-Bratzler device with V-blade, TMS-Pilot, Food Technology Corporation, USA). Sarcomere length was measured by laser diffraction (Coleman et al. 2016). Weight before and after cooking was recorded to calculate cooking loss, and drip loss was measured by suspending a 40mm$^3$ meat cube with a metal hook in a plastic bag, and then placing it in a chiller at 1°C (Coleman et al. 2016). Initial weight of sample and the

**Table 1** Means (±SEM) for meat-quality attributes of the striploin from Hereford x Friesian-Jersey steers aged 8, 10 or 12 months (n = 20 per group) at slaughter

| Meat-quality attribute | Slaughter age (months) | | | | |
|---|---|---|---|---|---|
| | 8 | 10 | 12 | SEM | Covariate P value Ultimate pH |
| pH | 5.31[a] | 5.58[c] | 5.52[b] | 0.01 | - |
| Meat colour | | | | | |
| L* (lightness) | 42.03[a] | 39.71[b] | 36.33[c] | 0.61 | <0.001 |
| a* (redness) | 12.29[a] | 14.97[c] | 13.86[b] | 2.59 | <0.001 |
| b* (yellowness) | 3.44[a] | 4.93[b] | 4.46[b] | 0.21 | <0.001 |
| Water-holding capacity | | | | | |
| Thaw loss (%) | 1.8[b] | 1.0[a] | 3.3[c] | 0.2 | NS |
| Cooking loss (%) | 28.7[a] | 27.8[a] | 26.5[b] | 0.3 | NS |
| Drip loss 48h (%) | 5.7 [b] | 4.1[a] | 6.4[c] | 0.6 | NS |
| Tenderness | | | | | |
| Shear force (kgF) | 5.1[b] | 4.6[a] | 5.6[b] | 0.3 | 0.05 |
| Sarcomere length (μm) | 1.72[a] | 1.74[a] | 1.75[a] | 0.1 | NS |

Values within rows that contain the same letter in their superscripts are not significantly different at the P<0.05 level.

weight after 48 hours were recorded.

Live weight, carcass weight and meat-quality attributes were analysed using general linear models (PROC GLM, SAS v. 9.4), with slaughter age as the fixed effect. Ultimate pH was used as a covariate when analysing meat-quality characteristics but when found to be not significant it was removed from the models.

## Results and discussion

The objective of the study was to compare meat-quality attributes obtained from dairy-origin cattle slaughtered at or before one year of age. Average daily live weight gain across the three slaughter groups from 100kg at three months age to 350kg at twelve months of age was 0.9kg/day. The final unfasted live weights of the steers slaughtered at eight, ten and twelve months of age were 252±6kg, 303±4kg and 348±5kg respectively. Carcass weights at eight, ten and twelve months of age were 119±3kg, 146±3kg and 174±2kg respectively. As expected, the slaughter live weight and carcass weights were heavier as slaughter age progressed.

Ultimate pH was lowest for the steers slaughtered at eight months of age (P<0.001; Table 1). Meat-quality attributes such as tenderness and colour can be influenced by ultimate pH (Purchas & Aungsupakorn, 1993). Lean-meat colour became darker as slaughter age increased (P<0.001) and redness increased between eight and ten months of age (P<0.001). This can be attributed to the increase in myoglobin concentration in the muscle as animals get older (Bures & Barton, 2012; Marencic et al. 2018).

Cooking loss, did not differ for steers slaughtered at 8 and 10 months of age, but was lower for the steers slaughtered at 12 months of age (P<0.001). Although there were some small differences in thaw loss, drip loss or cooking loss between the slaughter group, there was no clear trend for differences in water holding capacity between treatments. Carcass composition is being investigated as part of the larger study. The meat obtained was very lean and carcass composition was likely similar between all treatments, as would be expected given there was only four months difference in age between treatments.

There was no difference in sarcomere length between slaughter ages (P<0.371). The *M. Longissimus lumborum* (striploin) had a lower shear force at ten months old (4.6±0.3kgF) compared to eight and twelve months old (5.1±0.3 and 5.6±0.3kgF) (P<0.05), although the absolute differences were numerically small. In comparison, peak shear force observed from 24-month-old, beef-dairy prime steers averaged 9.6 kgF (Coleman et al. 2016). It is common for shear force values to increase as cattle get older, due to increased collagen crosslinking resulting in a decline in collagen solubility (Purchas & Grant, 2005). However, this relationship between age and collagen solubility is less consistent when cattle of a narrow age range are compared, which is likely why differences in shear force values were small in this study (Bures & Barton, 2012; Marencic et al. 2018). Shear force values above 10kgF for beef are detectable to consumers as "tough", while values below 8kgF can be recognised by consumers as "tender" (Bickerstaffe et al. 2001). Given that the average shear force values for all slaughter ages were less than 7kgF, in general the tenderness can be considered to be good without the need for ageing.

While there were some differences in objective meat-quality measures, they were unlikely to be large enough to impact on the eating quality, and hence value of the product on a cents/kg basis. However, the objective measures of meat-quality indicate that the yearling beef is tender and likely to be of high eating quality. This means that the beef obtained from cattle slaughtered between the ages of eight and twelve months could be classed and processed together under one category, and that the product could justifiably be marketed to markets that may offer a premium. As part of the larger study being undertaken, the consumer acceptability of the product and the economic feasibility of the system will be investigated. Consideration of growth rates and carcass yields will also be key to assessing efficiency and viability of a beef production system that utilises yearling cattle of dairy origin.

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