

Effects of pre-pubertal Burdizzo castration on performance, carcass characteristics and meat quality from young Holstein bulls fed high-concentrate diets

N. Mach^{1*}, C. Realini², M.F. Furnols², A. Velarde² & M. Devant¹

¹Animal Nutrition, Management, and Welfare Group, IRTA-Torre Marimon (Institut de Recerca i Tecnologia Agroalimentàries), Barcelona, 08140, Spain.

²IRTA Finca Camps i Armet, Monells, Girona, 17121, Spain.

*E-mail: nuria.mach@irta.cat.

Abstract

This study evaluated the effects of Burdizzo pre-pubertal castration on performance, carcass and meat quality from Holstein bulls fed high-concentrate diets. Two hundred bulls (8.0 ± 0.42 m) were randomly assigned to control (CTR) or Burdizzo castration (BURD). After 121 days, ADG (1.6 and 1.5 ± 0.05 kg/d, respectively), final BW (535 and 515 ± 2.4 kg, respectively) and HCW (283 and 267 ± 4.2 kg, respectively) were greater ($P < 0.05$) in CTR than in BURD. However, carcass degree of finishing was greater ($P < 0.05$) in BURD than in CTR (92.9% and 68% classified as “3”, respectively), as i.m. LT fat (4.1 and $2.6 \pm 0.23\%$, respectively). The LT area was lesser ($P < 0.01$) in BURD than in CTR (36.0 and 44.2 ± 1.90 cm², respectively). Additionally, CTR showed lesser L* ($P < 0.05$), a* ($P = 0.07$), and b* ($P < 0.01$) than BURD. While WBSF decreased in CTR ($P < 0.01$) with ageing time ($5.6, 4.2$ and 3.9 ± 0.20 kg at 0, 7 and 14 days), it remained constant after 7 days in BURD ($4.0, 3.1$, and 3.1 ± 0.20 kg at 0, 7, and 14 days). Pre-pubertal castration of Holstein bulls improved carcass and meat quality.

Introduction

Numerous research studies have been conducted to assess growth and meat characteristic differences between intact bulls and castrates. In general, results indicate that intact bulls grow more rapidly, utilize feed more efficiently, and produce carcasses with lesser degree of finishing, lesser intramuscular fat percentage, and lesser meat tenderness, with greater incidence of DFD meat (Morgan et al., 1993; Knight et al. 1999; Purchas et al., 2002) compared to castrates. Additionally, intact bulls present more aggressive and sexual behaviours, and consequently greater carcass bruising compared to castrates (Jago et al., 1997; Price et al., 2003). Differences in productivity between intact bulls and castrates begin at the pre-pubertal phase, which is attained at an average age of 6-7 months (Lunstra et al., 1978). Therefore, animals castrated around 8 months of age and slaughtered at 12 months of age might have an initial phase of improved growth and 4 additional months post-castration to improve carcass characteristics and meat quality. Thus, the aim of this study was to determine the effects of prepubertal castration on performance, carcass and meat quality from yearling Holstein bulls fed high-concentrate diets.

Materials and methods

Two hundred Holstein bulls (8.0 ± 0.42 m) were randomly assigned to 1 of the following treatments (n=100 bulls/treatment): 1) entire bulls as control (CTR); 2) Burdizzo castration (BURD). The BURD animals were castrated using a standard Burdizzo instrument (La Burdizzo, Corso Sebastopoli 187, Turin, Italy) as described by Fisher et al. (1996). One mL of local anaesthesia (Lidocaine hydrochloride 2%; Xilocaina Ovejero, Laboratorios Ovejero, Spain) was injected 10 min. before castration into each testicular cord, and 25 mL of none-steroidal anti-inflammatory (Flunixin Meglumine; Flunixin Inyectable Norbrook; Laboratorios Karizoo S. A., Spain) was injected via intramuscularly. Animals were fed concentrate and barley straw, both ad libitum, during 121 days of experiment, and housed in two identical buildings with 4 pens (25 ± 1 animals per pen) at a commercial farm (Montgai, Spain). The amount of concentrate and straw offered were recorded daily from 0 to 121 d. After 121 days of experiment, the amount of concentrate that remained in the silos and feeders was weighed in order to estimate the total amount of concentrate and straw consumptions. Animals BW were recorded on day -30, 0, 30, 60, 90, and 121 of experiment. At 121 days of study, 25 CTR animals (535 ± 2.4 kg) and 25 BURD animals (515 ± 2.4 kg), were randomly selected and transported together to the slaughterhouse. Following slaughter, HCW was recorded, and carcass degree of finishing and conformation were graded according to the EU classification system into 1.2.3.4.5 (EU Regulation n° 1208/81) and into (S)EUROP categories (EU Regulation n° 1208/81, 1026/91), respectively. The testes weight was also recorded at slaughter. Additionally, a sample of *Longuissimus Thoracis* (LT) from the 6th to 9th ribs was dissected and

evaluated for pH₂₄, LT area, instrument color values, intramuscular fat percentage, and Warner-Bratzler shear force evaluation at 3 ageing times (0, 7, 14 days).

Performance data were analyzed using mixed-effects ANOVA with repeated measures. The model included initial BW as a covariate, treatment, time, and the interaction between treatment and time, as fixed effects, and the animal and pen as random effect. Time was considered a repeated factor, and for each analyzed variable, animal nested within building, pen, and treatment (the error term) was subjected to compound symmetry variance-covariance structures. Carcass and meat quality characteristics were analyzed as described for performance but without the time effect (as there were no repeated measures), and final BW was used as a covariate.

Results and discussion

Concentrate intake (7.6 ± 0.08 kg of DM/d) and total DMI (8.4 ± 0.04 kg of DM/d) were not affected by castration. The BW difference between BURD and CTR animals increased linearly ($P < 0.001$) from day 0 to 121 days of study (from 10 ± 0.4 to 20 ± 0.4 kg). In addition, the ADG was greater ($P < 0.01$) in CTR bulls (1.6 ± 0.05 kg/d) than in BURD animals (1.5 ± 0.05 kg/d). The greater growth rate of entire bulls compared with castrates seems to be due to the greater production of natural anabolic hormones by the testes (Adams et al., 1996; Knight et al., 1999). Furthermore, the lesser performance observed in BURD animals could probably be due to the immediate tissue trauma, inflammation, and acute stress associated with castration (Early and Crowe, 2002; Fisher et al., 1996; Pang et al., 2006). Consequently, the final BW achieved after 121 d of castration, was greater ($P < 0.05$) in CTR animals (535 ± 2.4 kg) than in BURD animals (515 ± 2.4 kg). In addition, the HCW was greater ($P < 0.01$) in CTR animals (283 ± 4.2 kg) than in BURD animals (267 ± 4.2 kg), without differences in dressing percentage. Castration did not affect carcass conformation (89% classified as "O"). However, carcass classification for degree of finishing was greater ($P < 0.05$) in BURD animals (92.9% classified as "3") than in CTR bulls (68% classified as "3" and 32% classified as "2"), as it has been previously reported by Knight et al. (1999) and Morgan et al. (1993). As expected, the average weight of testes collected at slaughter was greater ($P < 0.001$) in CTR bulls (520.7 ± 29.96 g) than in BURD animals (169.71 ± 27.32 g). However, above 23% of BURD animals did not have a complete testicular atrophy, suggesting that the tension applied to the Burdizzo clamp when animals were castrated was not enough to cut off the blood supply to the testes and scrotum. Therefore, Burdizzo castration method might not be 100% safe to use in prepubertal cattle as a consequence of the great genital organs development. The intramuscular fat percentage was greater ($P < 0.001$) in BURD animals ($4.1 \pm 0.23\%$) compared with CTR bulls ($2.6 \pm 0.23\%$). In contrast, *Longissimus thoracis* area was lesser ($P < 0.01$) in BURD animals (36.0 ± 1.9 cm²) compared with CTR bulls (44.2 ± 1.90 cm²). Similar findings have been reported by other authors (Knight et al., 1999; Morgan et al., 1993). The LT pH (5.5 ± 0.01) was not affected by treatment. However, CTR bulls presented a darker LT than BURD animals at 24 h postmortem as indicated by the lesser L* value (34.7 ± 0.29 for CTR and 35.3 ± 0.29 for BURD animals, respectively; $P < 0.05$). *Longissimus thoracis* of CTR animals tended to have a lesser a* value (14.1 ± 0.75 for CTR and 15.5 ± 0.75 for BURD animals, respectively; $P = 0.07$), and lesser b* value (6.4 ± 0.55 for CTR and 7.2 ± 0.55 for BURD animals, respectively; $P < 0.01$) compared with BURD. There was an interaction ($P < 0.01$) between treatment and ageing time in instrumental tenderness as determined by Warner-Bratzler shear force. The shear force in CTR bulls was greater and decreased ($P < 0.01$) linearly with ageing time ($5.6, 4.2$ and 3.9 ± 0.20 kg at 0, 7 and 14 days, respectively), whereas in BURD animals the shear force values were lesser and did not decrease from 7 to 14 days of ageing ($4.0, 3.1$, and 3.1 ± 0.20 kg at 0, 7, and 14 days, respectively).

Conclusions

Prepubertal castration of Holstein bulls at 8 months of age with the Burdizzo technique reduced ADG, final BW, and HCW compared with entire bulls. However, castration improved carcass and meat quality, increasing carcass degree of finishing, intramuscular fat content, tenderness, and color lightness and redness. Despite the beneficial effects of pre-pubertal castration of Holstein bulls using Burdizzo technique on carcass and meat quality of bulls, the method of castration should be improved because above 23% of BURD animals did not have a complete testicular atrophy, suggesting that the Burdizzo method might not be 100% effective.

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