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Effect of immunocastration with Bopriva on carcass characteristics and meat quality of feedlot Holstein bulls

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ABSTRACT

To evaluate the effect of immunocastration on carcass and meat characteristics, Holstein bulls aged between 7 and 8 months with a live weight of 232 ± 1.19 kg were given two separate treatments, placebo (intact bulls) versus Bopriva, and then slaughtered after approximately 239 days of fattening. While the testosterone levels in intact bulls remained at 0.42 ng/ml throughout the study, by day 181, differences ($P < 0.05$) were observed in immunized bulls, with values of 0.21 ng/ml. The carcasses of animals treated with Bopriva recorded both a higher hot carcass weight (HCW) and a cold carcass weight (CCW), as well as higher dorsal fat density, marbling and KPH ($P < 0.05$); however, no differences ($P > 0.05$) were observed in the *Longissimus lumborum* area. No significant differences ($P > 0.05$) were recorded between the treatments for pH, L*, a*, b* C* and H*. The carcasses of the animals treated with Bopriva were heavier, with higher dorsal fat density and marbling score.

1. Introduction

Currently, producers of livestock for meat have considered the fattening of Holstein bull calves as an option, given that these animals offer certain advantages to the cattle farmer like the fact that they yield high quality carcasses, they can enter the feedlot with a weight of approximately 136 kg, and they can reach up to 590 kg after approximately one year of fattening (Duff & McMurphy, 2007).

However, if the calf bulls are not castrated, these animals can become dangerous (Duff & McMurphy, 2007), as a result of aggressive behavior both among themselves and toward their handlers, and they become difficult to handle. One method for reducing the occurrence of these events is through castration, this is accompanied with additional advantages, among which are enhanced carcass quality through improved body fat deposition, the reduction of aggressive and sexual behavior leading to easier handling, less carcass damage and improved animal welfare (Amatayakul-Chantler et al., 2012). However, this practice results stressful for the animal and is associated with reduced growth rates and post-operative infections (Price, Adams, Huxsoll, & Borgwardt, 2003). An alternative is immunocastration, which can bring the profits and advantages provided by the fattening of intact animals, increase the quality of the meat, and control undesirable behavior through a strategic immunization (Amatayakul-Chantler et al., 2012). This procedure acts by the injection of a GNRH analog, which generates an immune response such as that stimulated by a vaccine against a virus or a bacteria (Rault, Lay, & Marchant-Forde, 2011), thus stimulating the production of antibodies that both neutralize the GNRH and inhibit the secretion of sexual hormones. In light of the above, the objective of this study was to evaluate the effect that immunocastration with Bopriva has on the carcass characteristics and meat quality in fattened Holstein bulls.

2. Material and methods

2.1. Geographical location

The study was carried out in the city of Mexicali, Baja California, which is found at 32° 32′00 N, 115° 12′41 W. The region is characterized by a dry desert climate with an average temperature of 34.7 °C (−5 °C winter and 50 °C summer), with an annual rainfall of 37 mm, and a relative humidity above 50% (García, 1981). All animals were slaughtered at a Federal Inspection Type (TIF) slaughterhouse, following the methodology described in the Norma Oficial Mexicana NOM-033-ZOO-1995, "Humanitarian slaughtering of domestic and wild animals".

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2.2. Animals and design of the study

Holstein bulls from the same origin, aged between 7 and 8 months of age and with a live weight of 232 ± 1.19 kg were used. For the study two treatments were considered: four pens of 90 intact animals (placebo treatment) and four pens of 90 intact animals treated with Bopriva (Zoetis Laboratories Animal Health, México).

Twenty four hours after reception of the animals, the lots were structured, and the calves were vaccinated, dewormed, and an implant was placed (a trenbolone acetate, estradiol and tylosin product). Bopriva was administered subcutaneously on four occasions: (24 h after reception and on day 21, 101 and 181 of the experiment), while the calves in the placebo group were administered 1 ml of saline solution on the same days.

The live weight of each animal was recorded during each treatment. The animals were fed twice a day, following a program of 6 diets typical to the Northern region of the country, comprising wheat hay, sudangrass, tallow, DDG (Dried distillers grains), and a mineral premix. The animals were slaughtered once they had reached an average weight of 580 kg by day 239. The day of sacrifice the animals were herded by the cowboy on horseback for about 1 km to the slaughterhouse. The animals were kept in rest pens with access to water for approximately 6 h.

2.3. Serum testosterone levels

Ten animals per pen were randomly selected to measure serum testosterone levels. The animals selected for serum sampling were identified by an additional earing. Blood samples were taken every time that Bopriva was administered, and a sample was also taken during slaughter at the bleeding station on the production line at the slaughterhouse.

Approximately 5 ml of blood was extracted from the coccygeal vein. The samples were centrifuged at 3500 rpm to obtain serum, using a TRIAC centrifuge (Clay Adams, Model 0200, New Jersey, U.S.A.), and stored at −20 °C until the testosterone concentration was measured. The concentrations of serum testosterone were determined using the ENZO Testosterone Elisa Kit test (ADI-900-065), according to the manufacturer's instructions.

2.4. Carcass and meat quality

Carcasses from both *treatments* were chilled at 2 °C for 24 h and ribbed between the 12th and 13th ribs to collect additional carcass data. A total of 226 carcasses from the immunocastrated group and 208 carcasses from the placebo group were available by the slaughterhouse to be considered for the study of all the variables. The measurements of HCW and CCW, dorsal fat density, KPH (kidney, pelvic and heart fat), marbling, ribeye area, pH and color of each carcass were taken. Dorsal fat was measured in mm using a metric ruler, according by Hale, Goodson, and Savell (2013). The ribeye area was evaluated using a plastic grid method suggested by Iowa State University. The estimated quantity of kidney, pelvic and heart fat (% KPH) which was subjectively evaluated and expressed as a percentage of hot carcass weight (HCW), and the marbling score (scale of slight; small; modest; moderate; slight abundant; moderately abundant), were both evaluated following the methodology described by AMSA (2001). The pH was determined using a potenciometer (HANNAH INSTRUMENTS Inc. pH 101), the color values (L*, a*, b*, C*, H*) were measured on the surface of the cut from the *Longissimus lumborum* muscle between the twelfth and thirteenth intercostal space using a MINOLTA CM-2002 spectrophotometer (Minolta camera, Co., Ltd., Japan) with a specular component included (SCI), a D_{65} illuminant, and a 10° observer, where L* is the index of luminosity, a* is the red color intensity and b* is the yellow color intensity. Forty eight hours postmortem, a total of 80 meat samples of approximately 500 g were obtained from *Longissimus lumborum* muscle, 10 random samples per pen. The samples were vacuum packed, refrigerated and sent to the Meat Quality Laboratory for products of animal origin at the Instituto de Investigaciones en Ciencias Veterinarias at the Universidad Autónoma de Baja California, and subjected to shear force (SF) analysis using Warner-Bratzler blades. This test was conducted on pre-cooked 1 cm^2 meat samples obtained perpendicular to the muscle fibers using a meat core sampler, with measurements made using a texturometer (Lloyd Instruments, England). All measurements were carried out in triplicate.

3. Statistical analysis

The effects of the treatments on pH, color, and SF traits in the meat were analysed using the GLM procedure (SAS Inst. Inc., Cary, NC). The linear statistical model for the trial was as follows: $Y_{ij} = \mu + \tau_i + \xi_{ij}$ $i = 1, 2$; $j = 1, 2,\ldots,$ r where Y_{ij} is the response variable, μ is the true mean effect, τ_i is the fixed treatment effect (Bopriva vs placebo) and ξ_{ij} is the random residual error iid $N(0,\sigma_e^2)$. When the treatments represented a significant ($P \leq 0.05$) source of variation, differences between means for treatment were compared using Tukey's procedure.

Testosterone levels of each animal, which was recorded at days 1, 21, 101,181, and at the day of slaughter, was analysed with a linear mixed model for repeated measures using the MIXED procedure (SAS Inst. Inc., Cary, NC) using REPEATED statement. The linear statistical model was $Y_{ijk} = \mu + \tau_i + A_{k(i)} + D_j + (\tau D)_{ij} + \xi_{ijk}$ $i = 1, 2$; $j = 1, 2,\ldots, 5$, $k = 1, 2,\ldots,$ r where Y_{ij} is the response variable, μ is the true mean effect, τ_i is the fixed treatment effect (Bopriva vs placebo), $A_{k(i)}$ is the animal within treatment effect assumed iid $N(0,\sigma_a^2)$. D_j is the fixed days effect, $(\tau D)_{ij}$ is the treatment × days interaction effect, and ξ_{ijk} is the random residual error effect iid $N(0,\sigma_e^2)$. The analysis of repeated measures data requires appropriate accounting for correlations between the observations made on the same animal and heterogeneous variances among records over time, therefore unstructured (UN), compound symmetric (CS), and autoregressive of order 1 [AR(1)] covariance structures were tried and evaluated by using Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (BIC). The covariance structure with values of the criteria closest to zero was the most desirable. Thus, UN structure was chosen. When the treatment × days interaction represented a significant ($P \leq 0.05$) source of variation, differences between least square means for treatments by each day were compared using Tukey-Kramer's procedure (Steel & Torrie, 1985).

4. Results and discussion

4.1. Serum testosterone levels

The average testosterone levels on the day 1 were similar ($P > 0.05$) between immunocastrated group (0.26 ± 0.61 ng/ml) and placebo group of bulls (0.28 ± 0.60 ng/ml) (Fig. 1), at day 21 of fattening by

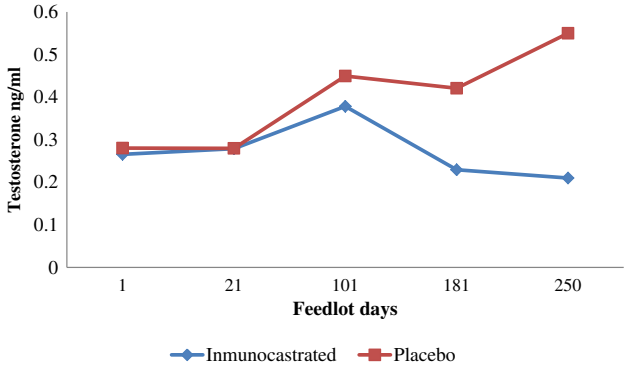

Fig. 1. Concentrations of serum testosterone by treatment.