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Immunocastration improves carcass traits and beef color attributes in Nellore and Nellore × Aberdeen Angus crossbred animals finished in feedlot

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ABSTRACT

The objective was to examine the effects of immunocastration on carcass traits and meat quality of Nellore and Nellore × Aberdeen Angus male animals finished in feedlot. Surgically castrated, immunocastrated, and intact animals were finished in feedlot for 90 days. The animals were harvested, and carcass traits were evaluated. Carcasses were chilled, and one 2.5-cm steak was fabricated from *Longissimus thoracis* muscle. The steaks were individually vacuum packaged and frozen at −18 °C. Frozen steaks were thawed, and pH, instrumental color, cooking loss, and shear force were determined. Immunocastrated animals demonstrated greater ($P < 0.05$) hot dressing percentage and cold dressing percentage than their surgically castrated counterparts. Furthermore, steaks from immunocastrated and surgically castrated animals exhibited greater redness ($P < 0.05$) and lower darkness ($P < 0.05$) than steaks from intact animals, indicating possible advantage in retailing. The results suggested that immunocastration may be utilized to improve carcass traits and beef color in feedlot-finished Nellore and Nellore × Aberdeen Angus males.

1. Introduction

Brazil is a major producer and exporter of beef (Ferraz & Felício, 2010). More than three-fourths of the Brazilian beef cattle are *Bos indicus* animals, of which Nellore is a major breed. *B. indicus* animals are late maturing compared to their European (*Bos taurus*) counterparts, and therefore Nellore animals have been crossbred with European breeds for genetic improvement of beef herds in Brazil. The crossbred animals demonstrate improved performance, carcass traits, and meat quality compared with *B. indicus* animals. However, a major disadvantage in raising crossbred animals in pasture is their high nutritional requirements; crossbreds require high energy diets for weight gain and fat deposition (Owens, Dubeski, & Hanson, 1993). While intramuscular fat contributes to eating experience, subcutaneous fat prevents moisture loss during carcass chilling. Thus, fat deposition affects profitability, and therefore raising crossbred beef cattle in pasture poses economic challenges. An alternative strategy is finishing crossbred cattle in feedlot, which provides high energy diet (Owens et al., 1993). Finishing beef cattle in feedlot is becoming a popular production practice in Brazil.

Modern-day beef production employs surgical castration to decrease aggressiveness as well as to improve carcass and meat quality traits. However, surgically castrated animals often exhibit low performance due to the decrease in androgenic hormones (Seidman, Cross, Oltjen, & Scjanbacher, 1982). Furthermore, surgical castration is often considered a questionable practice from the perspective of animal welfare (Bonneau & Enright, 1995). Immunological suppression of sex hormone production in beef animals reduced aggressive behavior and improved carcass quality (Huxsoll, Price, & Adams, 1998). The anti-GnRH vaccine stimulates the production of antibodies neutralizing GnRH and inhibits the release of sex hormones (Janett et al., 2012). Therefore, immunocastration can be used as an alternative to surgical castration to promote animal welfare. Since anti-GnRH vaccination exerts effect in a relatively short time, immunocastration can be applied in beef animals immediately before transferring to feedlot or while being finished in feedlot.

Immunocastration became relevant to Brazilian meat industry with the approval of the Ministry of Agriculture in 2010 for use in cattle.

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Recent studies evaluated the effect of immunocastration on pasture-raised Nellore cattle. Amatayakul-Chantler et al. (2013) reported that immunocastrated Nellore animals demonstrated greater loin eye area than their surgically castrated counterparts, whereas no differences were observed in hot carcass weight, fat thickness, and carcass yield. Additionally, Amatayakul-Chantler et al. (2013) did not observe any differences between immunocastrated and surgically castrated male Nellore animals for pH, tenderness, meat color, cooking loss, and fat color. These findings suggested that immunocastration is an animal welfare-friendly alternative to surgical castration in pasture-raised Nellore beef animals.

In a recent study, Amatayakul-Chantler et al. (2012) evaluated the influence of immunocastration in feedlot performance and meat quality of crossbred (Zebu × Brown Swiss) beef bulls in Mexico. The immunocastrated animals exhibited greater fat thickness at 12th rib, lower shear force, and lower ribeye area than the non-castrated males and animals castrated using anabolic implants. This study concluded that immunocastration influences meat quality attributes in feedlot-raised crossbred bulls.

The influence of immunocastration on carcass characteristics and meat quality of Nellore beef cattle finished in feedlot is yet to be investigated. Therefore, the objective of the present study was to examine the effects of immunocastration on carcass characteristics and quality attributes of beef from Nellore cattle finished in feedlot in comparison with crossbred animals.

2. Materials and methods

The animal care and handling procedures were approved (protocol 39/2012) by the Ethics Committee on Use of Animals at the Universidade Estadual Paulista, Botucatu, Brazil.

2.1. Animals and management

In this study, male beef animals from two genetic groups were used — (1) crossbred (50% Nellore × 50% Aberdeen Angus) from experimental farm of the Research Unit of the Agência Paulista de Tecnologia dos Agronegócios (APTA), Colina, Sao Paulo, Brazil; (2) purebred Nellore animals from a private farm in Colina, Sao Paulo, Brazil. The bulls were raised on pasture (*Brachiaria brizantha* cv. *Marandu*) from birth until their transfer to feedlot. The animals received a commercial protein-energy supplementation at the rate of 0.25% of bodyweight during wet period (October–March) and 0.5% of bodyweight during dry period (April–September).

Ten crossbred and 9 Nellore bulls were surgically castrated 28 days before transferring to feedlot. The surgery was performed under anesthesia. Ten crossbred animals and 10 Nellore animals were immunocastrated by vaccinating twice with anti-GnRH vaccine (Bopriva, Pfizer Animal Health) at 28 days and one day before their transfer to feedlot. Ten crossbred and 10 Nellore male animals were kept intact.

Animals were transferred to the feedlot, where they were randomly allotted to individual pens (10 m^2 area). The feedlot was located at the Research Unit of the APTA, Colina, Sao Paulo, Brazil. The crossbred bulls started the feedlot at an average weight of 505 kg and were between 19 and 21 months of age, whereas the Nellore bulls had an average weight of 424 kg and were between 21 to 25 months of age. All animals were given the same diet, housing, and management. The animals were subjected to 14 days for diet adaptation in the feedlot and were fed ad libitum high-grain diet containing 85% concentrate for 90 days. The animals were finished at the feedlot for 90 days.

2.2. Pre-slaughter handling and slaughter

The animals were fasted for 18 h on the day prior to transportation to the slaughterhouse. They were loaded into trucks in groups of 15 of the same genetic group and were transported to the slaughterhouse (Minerva Foods, Barretos, Sao Paulo, Brazil) 25 km from the feedlot. On arrival at the slaughterhouse, they were kept in resting pens and were humanely harvested under Brazilian federal inspection.

2.3. Carcass trait evaluation

Hot carcass weight (HCW) was measured, and hot dressing percentage was calculated using the live weight and the hot carcass weight. The carcasses were split into sides and were chilled overnight at 2 °C. After chilling, cold carcass weight (CCW) was recorded, and cold dressing percentage (CDP) was calculated using the live weight and the cold carcass weight. The weight loss during chilling was calculated as cooler shrink loss and was expressed as the percentage of HCW. Carcass length, depth of chest, length of leg, and leg perimeter were measured according to De Boer, Dumont, Pomeroy, and Weniger (1974).

2.4. Meat quality evaluation

2.4.1. Loin eye area and subcutaneous fat thickness

The carcasses were fabricated, and one 2.5-cm steak was cut from the *Longissimus thoracis* muscle at the 12th rib of the left sides. The outer perimeter of *Longissimus thoracis* muscle was directly traced on tracing paper, and the loin eye area was measured using the System Planimetry Digitizer software developed by the Remote Sensing Laboratory at the Universidade Estadual Paulista. Subcutaneous fat thickness was measured with digital calipers. The fabricated steaks were individually vacuum packaged and frozen at −18 °C until further analysis. Frozen samples were transferred to the Meat Laboratory of the Universidade Estadual Paulista. The frozen steaks were thawed overnight at 2 °C before evaluation of quality attributes.

2.4.2. Meat pH

The pH of the thawed steak was measured using a probe-type portable pH meter (Hanna Instruments, Woonsocket, RI, USA).

2.4.3. Instrumental color

Thawed steaks were removed from the vacuum packaging and were allowed to bloom for 30 min. CIE L^* (lightness), a^* (redness), and b^* (yellowness) values were measured on the surface at three random locations using a Minolta CR-400 colorimeter (Konica Minolta Sensing, Osaka, Japan) with illuminant C, 8 mm aperture, and 2° observer angle (AMSA, 2012).

2.4.4. Cooking loss

After removing subcutaneous fat, the steaks were cooked in a clamshell grill to an internal temperature of 71 °C. Internal temperature was measured using a digital thermometer inserted at the geometric center of the steak. The steaks were weighed before and after cooking. Cooking loss was calculated from the difference in the weight of raw and cooked steaks and was expressed as percentage of initial weight.

2.4.5. Shear force

The shear force was measured according to AMSA (1995). After determining cooking loss, the cooked steaks were stored for 12 h at 4 °C. Six cylindrical cores of 1 cm diameter, in the direction of the muscle fiber, were taken from the samples. These cores were sheared using Warner–Bratzler probe attached to a TA-TX2i texture analyzer (Stable Micro System, Surrey, United Kingdom) set at a speed of 20 cm/min.

2.5. Statistical analysis

The experiment was a 2 × 3 factorial (2 genetic groups × 3 sexual conditions) in a completely randomized design. Data were analyzed through the MIXED procedure (SAS, 1999) using covariate. The covariate used was the bodyweight of the animals 40 days prior to the transfer