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Effect of high oil corn in the diets of Nellore steers on growth performance, carcass characteristics, meat quality, and longissimus muscle fatty acid profile

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ABSTRACT

The objective in this study was to evaluate the effects of substituting high oil corn (HOC) for typical corn (TC) on performance, carcass characteristics, meat quality, and longissimus muscle (LM) fatty acid profile of Nellore steers fed diets containing different amounts of corn. Forty-eight individually fed Nellore steers (441 ± 32 kg initial body weight) were allocated by body weight to four pens equipped with electronic gates in a randomized complete block design with six treatments in a 2 × 3 factorial arrangement of treatments, with two corn types (CT) and three corn levels (CL). Treatments consisted of diets containing 25, 40, or 55% TC or HOC on a dry matter (DM) basis. Animals were confined for 84 days so that DM intake and average daily gain (ADG) were measured individually. After the feedlot period, animals were slaughtered at a commercial slaughterhouse, carcass characteristics were evaluated, and LM samples were collected for further analyses of meat quality and fatty acid profile. Statistical analyses were conducted using the MIXED procedure of SAS. No differences among CL and CT were observed for DM intake, metabolizable energy intake, gain to feed ratio, and dietary net energy for maintenance and gain. Steers receiving HOC had greater ADG in comparison with those fed TC when CL was 25%, but no differences were observed when CL was 40 or 55%. Cooking loss and LM redness were linearly decreased ($P \leq 0.05$) with the increasing CL. No effects of CL and CT were observed for any other carcass characteristics and meat quality variables. The LM proportions of stearic, linolenic, and total omega-6 fatty acids, as well as omega-6 to omega-3 fatty acids ratio (n-6:n-3), were linearly increased ($P \leq 0.04$) as CL increased, whereas conjugated linoleic acid (CLA) proportions showed a quadratic response ($P < 0.01$) to corn inclusion, with lower values observed for steers fed 40% corn. Longissimus muscle proportions of myristic and palmitic acids were decreased ($P \leq 0.02$), whereas proportions of CLA, total omega-6, and total polyunsaturated fatty acids, as well as n-6:n-3, were increased ($P \leq 0.04$) when TC was replaced with HOC. In

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conclusion, replacing TC with HOC in the diets of Nellore steers fed different corn levels had no effects on animal performance, carcass characteristics, and meat quality, but improved LM fatty acid profile, which suggests that the produced beef might be healthier for consumers.

1. Introduction

Feeding high grain diets to finishing beef cattle can improve growth performance and increase fat deposition due to their higher energy density. However, increasing energy content of the diets by increasing concentrate levels may result in metabolic disorders, such as ruminal acidosis (Krause and Oetzel, 2006). Additionally, the majority of the Brazilian feedlot herd is composed of Zebu breeds, which are observed to develop these metabolic disorders more frequently than European breeds (Elam, 1976). In this way, an interesting option to increase energy density is the addition of fat to the diets. The supplementation of finishing diets with fat may enhance beef cattle performance (Brandt and Anderson, 1990; Krehbiel et al., 1995; Zinn, 1992) and carcass characteristics (Brandt and Anderson, 1990; Zinn, 1992), and change the pattern of lipid deposition (Andrae et al., 2001).

An alternative fat source for beef cattle diets is high oil corn (HOC), which is obtained through genetic selection. High oil corn contains 7 to 8% ether extract on dry matter (DM) basis, nearly twice as much as typical corn (TC; Andrae et al., 2000). Replacing TC with HOC in finishing beef cattle diets may increase the supply of unsaturated fatty acids and energy density, which in turn can enhance animal performance and alter the composition and amount of fat deposited (Andrae et al., 2000, 2001). Therefore, the objective in this research was to evaluate the effects of substituting HOC for TC on growth performance, carcass traits, meat quality, and longissimus fatty acid composition of confined Nellore steers fed diets containing three different levels of corn inclusion.

2. Materials and methods

The experiment was carried out in the College of Animal Science and Food Engineering, University of São Paulo (Pirassununga, São Paulo, Brazil), and research protocols using animals followed guidelines in the Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching (FASS, 2010). Forty-eight Nellore steers, approximately 30 months of age and 441 ± 32 kg of initial body weight (BW), were allocated to four different pens (10 m × 23 m) which accommodated 12 individual sheltered bunks equipped with electronic gates (Calan-Broadbent System; American Calan, Northwood, NH, USA). Pens were soil-surfaced and contained automatic water fountains. Animals were blocked by initial BW and each pen represented a block in a randomized complete block design with six treatments in a 2 × 3 factorial arrangement, with two corn types and three corn levels. Dietary treatments consisted of total mixed rations containing 25, 40, or 55% TC or HOC on a DM basis, and their compositions are shown in Table 1. Typical corn and HOC were provided to steers as dry ground corn.

Initially, all animals were submitted to a 28-d adaptation period, when concentrate levels were gradually increased, and also allowed to train them to use the electronic gates. At the end of the adaptation period, steers were weighed after an 18-h fasting period, and then confined for 84 d. Total mixed rations were fed twice daily for ad libitum intake at 0800 h and 1700 h, and the amounts of feed offered were adjusted daily (5 to 10% refusal). Corn silage samples were analyzed weekly for DM to ensure a constant forage to concentrate ratio.

Samples of feed and orts were collected weekly and frozen at −20 °C. At the end of the experiment, samples were composited for each animal, dried at 55 °C for three days, ground using a Wiley laboratory mill (1-mm screen), and analyzed for their chemical composition to estimate total digestible nutrients (TDN) according to Weiss et al. (1992). Samples were analyzed for DM, ash, ether extract, crude protein (Association Of Official Analytical Chemists, 1990), neutral detergent fiber (Van Soest et al., 1991), acid detergent fiber, lignin (Association Of Official Analytical Chemists, 1990), neutral detergent insoluble crude protein, and acid detergent insoluble crude protein (Licitra et al., 1996). Alpha-amylase was used in the determinations of neutral detergent fiber.

Animals were weighed every 28 d after an 18-h fasting period, and average daily gain (ADG) was obtained as the angular coefficient of the linear regression of BW on time. Dry matter intake (DMI) was calculated as the difference between feed offered and orts, which were daily weighed. Gain to feed ratio (G:F) was determined by the division of ADG by DMI. Total digestible nutrients were converted to metabolizable energy (ME) according to the National Research Council (2000) so that metabolizable energy intake (MEI) could be estimated. Dietary net energy for maintenance (NEm) and for gain (NEg) based on feed analyses were also calculated according to the National Research Council (2000).

In order to estimate dietary NEm and NEg based on performance, energy gain (EG, Mcal/d) was calculated according to the National Research Council (2000) by the equation: $EG = 0.0557 \times \text{mean BW} \times (SRW/FSBW)^{0.75} \times ADG^{1.097}$, where SRW is the standard reference weight (435 kg when average marbling score = traces), and FSBW is shrunk BW at the end of the experiment (519.1 kg). Maintenance energy expended (EM, Mcal/d) was determined by the following equation: $EM = 0.077 \times BW^{0.75}$ (Lofgreen and Garrett, 1968), and the result was multiplied by a correction factor of 0.9 for *Bos indicus* breeds (National Research Council, 2000). Estimated dietary NEm and NEg (Mcal/kg) were calculated by the following equations proposed by Zinn and Shen (1998): $NEm = (-b - (b^2 - 4ac)^{0.5})/2c$, where $a = -0.41EM$, $b = 0.877EM + 0.41DMI + EG$, and $c = -0.877DMI$;