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Short communication

Effects of detoxified *Jatropha curcas* kernel meal in finishing pig diets on their performance, carcass traits, meat quality and intoxication

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ABSTRACT

Jatropha meal, produced as co-product of biodiesel production process, can be used in animal diets as a feedstuff. Hence, the purpose of this study was to evaluate effects of increasing dietary levels (0%, 2%, 4%, 6%, and 8%) of detoxified *Jatropha curcas* kernel meal (DJCM) on performance, carcass traits, meat quality, and intoxication of bioactive molecules, such as the phorbol esters, by hepatic transaminase enzymes in finishing pigs. Sixty hybrid crossbred pigs (70.7 ± 3.3 kg body weight, BW) were assigned to 5 treatments with 6 replicate pens per treatment and 1 castrated male and 1 female per pen in a randomize complete block design. Isoenergetic and isoproteic diets and water were provided ad libitum to the pigs during 30-d growth study. At the end of the experimental period, pigs were slaughtered and hot carcass yield weight, carcass length, backfat thickness, loin eye area, and muscle-to-fat ratio were determined. In addition, blood samples were collected for the analysis of hepatic enzymes, and *Longissimus dorsi* muscle samples were also collected for the measurement of pH, color, and water drip loss. Increasing dietary levels of DJCM reduced ($P < 0.001$) final BW, ADG, ADFI, and carcass length quadratically, and hot carcass weight and backfat thickness linearly ($P < 0.05$). No effects were observed on meat quality with the dietary inclusion of DJCM. Increasing levels of dietary DJCM showed a negative quadratic effect ($P < 0.05$) on aspartate aminotransferase hepatic enzyme without any effects on alanine aminotransferase. In conclusion, the DJCM decreased growth performance and carcass traits because of the presence of bioactive molecules. Further studies are needed to investigate the effect of bioactive molecules present in DJCM and the possibility of removing those bioactive compounds.

1. Introduction

In the swine production, feed represents nearly 70% of the production costs. In many countries, pig diets are based on corn and soybean meals. However, frequent fluctuations have been observed in the market with regard to the supply and cost of ingredients, which has negative consequences on the production costs and profitability of the swine production. These factors have led researchers and producers search for alternative sources to replace traditional feedstuffs used in pig diets. In recent years, the production and use of renewable energy sources has been intensified and a considerable attention has been paid to biodiesel production. Its production process generates a

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variety of by-products that must be used in some way to add value to the production process, thus, making biodiesel production economically viable.

Some of these by-products have been considered as a possible feed ingredient for animal diets. Among the crops currently used in the production of biodiesel, Jatropha (*Jatropha curcas* L.) has a great potential because of its characteristics and worldwide distribution, especially in the countries in Latin America, Asia, and Africa (Gubitz et al., 1999). The Jatropha seeds have high oil content (50–60% when the extraction is performed using solvents and 35% when the extraction is performed under pressure), which is good for biodiesel production (Openshaw, 2000). The Jatropha meal, produced as a result of biodiesel process, can be used in animal diets as a source of protein and energy. However, Jatropha seed contains bioactive molecules, e.g., phorbol esters, which can show some clinical symptoms such as diarrhea, dehydration, and dyspnea when fed to animals (Becker and Makkar, 1998). These molecules can be removed from the meal by a suitable economical process, improving its nutritional value for animals.

Wang et al. (2011) demonstrated that the detoxified *Jatropha* kernel meal supplemented with additional Lys can replace 50% of the soybean meal protein in the diets for growing pigs without any negative effects on health and growth performance. However, Chivandi et al. (2006) observed negative responses in weaned pigs to diets with detoxified and extruded DJCM. The purpose of this study was to evaluate the effects of increasing dietary levels (0%, 2%, 4%, 6%, and 8%) of DJCM on growth performance, carcass traits, meat quality, and hepatic transaminase enzymes in finishing pigs.

2. Material and methods

2.1. Animals housing and experimental design

The protocol for experimental procedures was approved by the Ethics committee for the use of animals (University of São Paulo, Piracicaba, SP, Brazil). Sixty crossbred pigs, averaging 70.7 ± 3.3 kg body weight (BW), were assigned to 5 treatments with 6 replicate pens and 1 castrated male and 1 female per pen in a randomized complete block design. The experiment was carried out on a commercial operation (St. Peter Pig Farm, Cordeirópolis, São Paulo, Brazil). The pigs were housed in 2×2 m^2 pens with a partially slatted concrete floor, a single spaced semiautomatic feeder, and a nipple drinker in a naturally ventilated building. Feed and water were provided ad libitum to pigs throughout the 30-d growth study. Before starting the experiment, all animals were transferred to the finishing phase facilities where they received a basal diet for 1 week.

2.2. Dietary treatments and diets

The dietary treatment consists of a corn–soybean meal basal diet (control treatment) and 4 inclusion levels (2%, 4%, 6%, and 8%) of DJCM (Table 1). The DJCM used for feeding study were obtained from a commercial source. The isonutritive diets were formulated based on the nutrient requirements of pigs (Rostagno et al., 2011).

2.3. Growth performance and carcass traits

Individual pig BW and pen feed disappearance were recorded at 7-d intervals during the experimental period to determine ADG, ADFI, and feed conversion ratio. At the end of the 30-d growth study, 1 pig per experimental unit (3 males and 3 females/treatment) were slaughtered, scalded, dehaired, and eviscerated. Immediately after evisceration, carcasses were weighed to calculate the dressing percentage and split longitudinally for the measurements of carcass length, backfat thickness, loin eye area, and muscle-to-fat ratio according to the Brazilian Method for Carcass Evaluation (ABCS, 1973).

2.4. Meat quality

Longissimus dorsi samples were collected and stored at 4 °C for 24 h, and, then, samples were analyzed for color, pH, and water drip loss. For instrumental color analysis, 2.5 cm samples of *Longissimus dorsi* muscle were used for the measurement of brightness (L), red tendency (a), and yellow tendency (b). Color was determined with the aid of a portable colorimeter (Model XE MiniScan; HunterLab, Reston, VA) using the scale L*, a*, b*(CIE Lab system), with a D65 light source, observation angle 10, and opening of the measuring cell of 30 mm. The coordinates of CIE L* a* b* samples were obtained by moving the apparatus on 4 adjacent positions to sample the entire available surface of the cut. The pH analysis was performed with 4 point calibration and automatic temperature compensation machine, which features temperature sensor and pH electrode (Model DT50-DIGIMED; Micro-Med, Louisville, KY). Measurements were made on 4 points of the sample taken from the muscle. The 2.5 cm samples of *Longissimus dorsi* muscle were weighed and suspended in nylon net inside a plastic bag at 4 °C for 72 h, and dried and weighed again, and the percentage of weight loss was calculated (Dirinck et al., 1996).

2.5. Analysis of liver transaminase enzymes

During slaughter, blood samples were collected in tubes with ethylene diaminetetraacetic acid (EDTA) from the animal and centrifuged at 3000*g* for 3 min at room temperature to separate the serum. The activity of enzymes, alanine aminotransferase (ALT) and aspartate aminotransferase (AST) was determined using a commercial kit (BIOCLIN, Minas Gerais, Brasil) by colorimetric analysis in a spectrophotometer, with the temperature ranging between 20 and 30 °C.

2.6. Statistical data analysis

The adequacy of the data to the linear model was verified by SAS LAB and the analysis of variance was performed using the GLM procedure of SAS (SAS Instit. Inc., Cary, NC, USA). In addition, the degrees of freedom of the factor level were partitioned into its individual components (linear, quadratic, cubic, and quartic) through the orthogonal polynomials regression. For the carcass traits data, the slaughter BW was used as a covariate to adjust carcass variables to a common slaughter BW.

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