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Energy and amino acid digestibility of camelina cake fed to growing pigs

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ABSTRACT

This experiment was conducted to determine the apparent (AID) and standardized ileal digestibility, (SID) of crude protein (CP) and amino acids (AA), the digestible (DE), metabolizable (ME) and calculated net energy (NE) values of screw-pressed camelina cake (SPCC) fed to growing pigs. Six ileal cannulated barrows [(Yorkshire-Landrace) × Duroc] with an average BW of 80 kg were assigned to two experimental diets in a two period crossover design to give six observations per diet. Each period lasted for 10 d; the initial 5 d for diet adaptation, followed by 3 d for urine and feces collection, and 2 d for ileal digesta collection. Pigs were fed either a corn–soybean meal basal diet formulated to meet NRC (1998) (Nutrient Requirements of Swine, 10th ed. National Academic Press, Washington, DC) nutrient requirements for 50 to 80 kg pigs or the basal diet with a portion of the corn and soybean meal replaced by 200 g/kg SPCC. The daily feed allowance was set at 40 g/kg BW at the beginning of each period and offered in two equal portions at 0800 and 1600 h. Titanium dioxide (3 g/kg) was included as an indigestible marker. The AID and SID of CP and AA as well as DE and ME values in SPCC were determined by the difference method. The SID of CP and AA was calculated using published values for basal endogenous AA losses obtained from our laboratory and NE was calculated using the determined components from chemical analyses. The GE, CP, lysine, methionine, threonine, ether extract, NDF, ADF and glucosinolate contents of SPCC (on a DM basis) were 21.5 MJ/kg, 381, 18, 6.8, 16.8, 119, 315, 203 g/kg and 36.3 μmol/g, respectively. The SID coefficient of CP for SPCC was 0.65. The coefficient of SID of lysine, methionine and threonine for SPCC were 0.58, 0.53 and 0.53, respectively. The DE, ME, and calculated NE values of SPCC were 17.5, 16.2 and 10.2 MJ/kg, respectively. In conclusion, SPCC has potential as an energy source given its remaining oil content, however, its digestibility coefficients for AA and CP were low, and could limit its utilization in swine diets. The SID AA, DE, ME, and calculated NE values of SPCC obtained from the current study could be used when formulating diets and to obtain predictable animal performance.

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Abbreviations: AA, amino acids; ADF, acid detergent fibre; AID, apparent ileal digestibility; ATTD, apparent total tract digestibility; CP, crude protein; SPCC, screw-pressed camelina cake; DE, digestible energy; EE, ether extract; GE, gross energy; ME, metabolizable energy; NDF, neutral detergent fibre; NE, net energy; SID, standardized ileal digestibility.

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1. Introduction

Camelina (*Camelina sativa*), an oilseed crop of the *Brassica* family, is mainly grown in temperate regions like Canada for use in the biodiesel industry and production of vegetable oil for human consumption (Wittkop et al., 2009). Also, camelina oil has potential in biojet fuel production (Shonnard et al., 2010). Its seed yield and oil content are comparable to those of canola (Blackshaw et al., 2011). However, camelina is more tolerant to frost, heat, and drought than canola (Wittkop et al., 2009). Further, camelina has a higher content (380 *vs*. 100 g/kg) of α-linolenic acid than rapeseed oil (Karvonen et al., 2002). Thus, camelina is gaining bioindustrial importance and its production in temperate regions is projected to increase (Lu et al., 2011).

Screw-pressed camelina cake (SPCC), a co-product of oil extraction from camelina, is likely to become increasingly available for use in livestock feeds due to a projected increase in camelina production (Lu et al., 2011). Because SPCC has a high protein (>300 g/kg) and remaining oil (>100 g/kg) content (Pekel et al., 2009), it has potential as a dietary source of protein and energy in swine. Deposition of omega-3 fatty acids in eggs and meat is enhanced in poultry fed diets containing camelina cake (Thacker and Widyaratne, 2012; Kakani et al., 2012).

Inclusion of camelina cake at levels up to 100 g/kg of a poultry feed had no detrimental effect on growth performance (Aziza et al., 2010) or feed efficiency (Thacker and Widyaratne, 2012). However, studies on performance and the nutritive value of camelina cake fed to pigs are scarce. To our knowledge, amino acid (AA) digestibility of camelina cakes for pigs has only been determined in one study (Almeida et al., 2013), which reported standardised ileal AA digestibility coefficients of 0.68 to 0.72, 0.76 to 0.84, and 0.59 to 0.67 for Lys, Met and Thr, respectively, in expeller-extracted camelina cake. However, no study has determined the energy value of SPCC for pigs. Thus, the objective of this study was to determine AA digestibilities, digestible (DE) and metabolizable energy (ME) value and calculate the net energy (NE) value of SPCC when fed to growing pigs.

2. Materials and methods

The experimental procedures used in this experiment were reviewed and approved by the University of Manitoba Animal Care Protocol Management and Review Committee (Protocol #: F09-008/1/2) and pigs were cared for according to the Canadian Council on Animal Care Guidelines (CCAC, 2009).

2.1. Experimental animals

Six crossbred barrows ([Yorkshire-Landrace dam] × Duroc sire) were obtained from the University of Manitoba's Glenlea Swine Research Unit (Winnipeg, Manitoba) and housed individually in 1.5 × 1.2 m pens with smooth sides and plastic-covered expanded metal flooring in a temperature controlled room (22 °C). Pigs at 27 kg had been surgically fitted with a simple T-cannula at the distal ileum as described by Nyachoti et al. (2002) and used in a study to determine the effect of phytase supplementation on nutrient digestibility of regular and low phytate field pea. Pigs were given a 2-wk rest period during which they were fed a commercial grower diet before the start of the current study at an average BW of 80.2 ± 7.5 kg (mean + standard deviation).

2.2. Experimental diets

The two diets fed in this study included a complete corn–soybean meal basal diet that was formulated to meet NRC (1998) nutrient recommendations for 50 to 80 kg pigs, as well as a similar diet in which 20.6% of both corn and soybean meal were replaced by 200 g/kg SPCC (Table 1). The SPCC was included in the assay diet at 200 g/kg because the pigs had previously been unable to eat sufficient amount of diets that contained 300 g/kg SPCC. The basal diet was fed to determine nutrient digestibility and retention by the difference method (Adeola, 2001). The SPCC was sourced from Canpressco Products (Midale, SK, Canada). The SPCC tested in the current study was extracted at 54 °C (barrel temperature) and at a screw speed of 25 revolutions per min. The corn and soybean meal were sourced from a local supplier. Titanium dioxide was included in the experimental diets at 3 g/kg as an indigestible marker.

2.3. Experimental procedure

Pigs were assigned to the test diets in a 2-period crossover design. Each experimental period lasted 10 d comprising of a 5-d period for diet adaptation followed by 3 d for total but separate fecal and urine collection and 2 d for collection of ileal digesta. Pigs were fed at 40 g/kg BW at the beginning of each period. The daily allowance was offered in two equal portions at 0800 and 1600 h. Total fecal and urine samples were collected on d 6, 7 and 8 as described by Woyengo et al. (2010) and stored frozen for later analyses. Ileal digesta were collected for 12 h continuously from 0800 to 2000 h on d 9 and 10 as described by Nyachoti et al. (2002) and stored at −20 °C until analysis.

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