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Nutrient digestibility of canola co-products for grower pigs

T.A. Woyengo[a], J.E. Sánchez[a,b], J. Yáñez[a,c], E. Beltranena[a,d], M. Cervantes[b], A. Morales[b], R.T. Zijlstra[a,*]

[a] Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, Alberta T6G 2P5, Canada
[b] Instituto de Ciencias Agrícolas, Universidad Autónoma de Baja California, Mexicali, 21100, Mexico
[c] Escuela de Medicina Veterinaria y Zootecnia, Universidad Autónoma de Tlaxcala, Tlaxcala, 90500, Mexico
[d] Alberta Agriculture and Forestry, Edmonton, Alberta T6H 5T6, Canada

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ABSTRACT

A study was conducted to determine the coefficient of standardized ileal digestibility (CSID) of amino acids (AA) and calculate net energy (NE) for 4 canola co-products namely: *Brassica (B.) juncea* canola meal and *B. napus* canola meal, *B. napus* expeller and *B. napus* press-cake for growing pigs. From canola seed, the co-product meal is from solvent extraction, expeller from expelling after conditioning and press-cake from pressing without conditioning. Five ileal-cannulated barrows (initial body weight = 65.7 kg) were fed 5 diets in a 5 × 5 Latin square. Five diets were maize starch-based diets with one of each of 4 canola co-products as sole source of protein and an N-free diet. The CSID of AA for diets was calculated using the N-free diet. Amino acid digestibility was determined by the direct method, whereas gross energy (GE) digestibility of test feedstuffs was determined by difference from the N-free diet. On as is basis, *B. juncea* canola meal and *B. napus* canola meal, expeller and press-cake contained 381, 384, 391 and 248 g/kg crude protein; 19.9, 21.4, 22.6 and 13.8 g/kg lysine; 24.6, 28.5, 104 and 313 g/kg ether extract and 183, 261, 231 and 182 g/kg neutral detergent fibre, respectively. The CSID of lysine, coefficient of apparent total tract digestibility (CATTD) and calculated NE value were greater ($P < 0.05$) for *B. juncea* canola meal than for *B. napus* canola meal (0.79 vs. 0.72, 0.79 vs. 0.67, 9.7 vs. 8.3 MJ/kg; respectively). The CSID of lysine for *B. napus* canola meal (0.72) and *B. napus* canola press-cake (0.68) did not differ, but was lower ($P < 0.05$) than that for *B. napus* canola expeller (0.80). The CATTD of GE for *B. napus* canola meal (0.67) and *B. napus* canola press-cake (0.64) did not differ, but was lower ($P < 0.05$) than that for *B. napus* canola expeller (0.74). However, the calculated NE value for *B. napus* canola press-cake (10.9 MJ/kg) was greater ($P < 0.05$) than that for *B. napus* canola expeller (10.5 MJ/kg), but both were greater ($P < 0.05$) than that for *B. napus* canola meal (8.3 MJ/kg DM). In conclusion, *B. juncea* canola meal had greater CSID of AA and calculated NE value than *B. napus* canola meal, indicating that *B. juncea* canola meal can contribute more dietary digestible AA and energy to the pig than *B. napus* canola meal. Differences in CATTD of GE, NE value and CSID of AA data among *B. napus* canola co-products indicate that method of oil extraction from canola seed can affect energy and AA availability in the resulting canola co-products.

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Abbreviations: AA, amino acids; ADF, acid detergent fibre; BW, body weight; CAHD, coefficient of apparent hindgut fermentation; CAID, coefficient of apparent ileal digestibility; CATTD, coefficient of apparent total tract digestibility; CSID, coefficient of standardized ileal digestibility; CP, crude protein; DE, digestible energy; DM, dry matter; EE, ether extract; GE, gross energy; NDF, neutral detergent fibre; NE, net energy; PC, principal component.

* Corresponding author.
E-mail address: ruurd.zijlstra@ualberta.ca (R.T. Zijlstra).

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1. Introduction

Increasing demand for raw cereal grains and oilseeds by the food and biofuel industries has increased the cost of swine feeds (Schmit et al., 2009; Zijlstra and Beltranena, 2012). Co-products from these industries can be included in swine diets instead (Woyengo et al., 2014). However, the nutritive value of co-products needs to be determined to optimize their use in swine diets.

Canola is a major oilseed crop that is grown in temperate regions such as Canada for production of oil for food and biofuel industries (FAO, 2004). Species of canola include *Brassica (B.) napus* and *B. juncea*. *Brassica napus* is the most widely grown canola, whereas *B. juncea* is a novel species that grows well in areas of the Northern Great Plains that receive less rain (Bueckert and Clarke, 2013). Oil is extracted from canola seed by expeller pressing, cold pressing or solvent extraction after expeller pressing (Spragg and Mailer, 2007). Of these, solvent extraction is used most common, producing canola meal containing less than 30 g oil/kg. Pressing without solvent extraction produces canola co-products containing more than 100 g oil/kg (Spragg and Mailer, 2007). Expeller pressing but not cold pressing has an initial step of conditioning the seed using steam prior to expelling. The steam provides especially heat that will enhance oil extraction; hence, canola press-cake contains more oil than canola expeller. The nutritional value of *B. napus* canola meal for pigs has been determined (Bell, 1993; Mariscal-Landín et al., 2008; Seneviratne et al., 2010; Woyengo et al., 2010; Maison and Stein, 2014). However, information on the nutritional value, chemical composition and in vivo energy and nutrient digestibility of *B. juncea* canola meal and *B. napus* canola expeller and press-cake for pigs is minimal. Porcine in vitro digestion and fermentation of *B. juncea* canola meal, and *B. napus* canola meal, expeller and press-cake has been defined (Woyengo et al., 2016).

We hypothesized that the nutritional value of canola co-products would not vary between species and among oil extraction methods. The objectives of the present study were to determine and compare the digestible energy (DE) and calculated net energy (NE) values and coefficient of standardized ileal digestibility (CSID) of amino acids (AA) for *B. napus* canola meal, with those of *B. juncea* canola meal, *B. napus* canola expeller and *B. napus* canola press-cake fed to growing pigs; and to establish interrelationships between chemical composition and energy and nutrient digestibility for canola co-products.

2. Materials and methods

Experimental procedures were reviewed and approved by the University of Alberta Animal Care and Use Committee for Livestock. Pigs were handled in accordance with the guidelines described by the Canadian Council on Animal Care (CCAC, 2009).

2.1. Experimental animals

Five crossbred barrows (initial body weight [BW] 65.7 ± 1.7 kg; Duroc × Large White/Landrace F_1; Genex Hybrid, Hypor, Regina, SK, Canada) were surgically fitted with a T-cannula at the distal ileum (Sauer and Ozimek, 1986). Pigs were housed individually in metabolism pens (1.2 × 1.2 m) that allowed freedom of movement in a temperature-controlled room (22 ± 2 °C). Pens had plastic-coated expanded metal floor, polyvinyl chloride walls (0.9 m high) fitted with Plexiglas windows (0.3 × 0.3 m), a single-space dry feeder and a cup drinker.

2.2. Experimental diets

Five diets were formulated and included four maize starch-based diets with *B. juncea* canola meal, *B. napus* canola meal, *B. napus* canola expeller or *B. napus* canola press-cake as the sole source of protein; and one N-free diet (Table 1). Diets contained 5 g Cr_2O_3/kg as an indigestible marker. The ratio of maize starch to sugar and canola oil in diets containing the four canola co-product diets was identical to the N-free diet to allow calculation of energy digestibility using the difference method (Stein et al., 2006). Samples of *B. juncea* canola meal, *B. napus* canola meal, *B. napus* canola expeller and *B. napus* canola press-cake were obtained from Bunge Canada (Altona, MB, Canada), Bunge Canada (Fort Saskatchewan, AB, Canada), Viterra Canola Processing (Ste. Agathe, MB, Canada) and Cansource Biofuels (Mayerthorpe, AB, Canada), respectively.

2.3. Experimental design and procedure

The experiment was conducted as a 5 × 5 Latin square to achieve 5 observations per diet. Each period consisted of 9 days: the first 5 days for adaptation, followed subsequently by 2 days of faecal collection and 2 days of ileal digesta collection. Pigs were fed diets at 3 times maintenance energy requirement (3 × 460 kJ of DE/kg of $BW^{0.75}$; NRC, 2012) based on BW at the beginning of each period. Daily feed allowance was divided in 2 equal portions at 0800 and 1500 h. Faeces were collected continuously in plastic bags fitted around the anus that were replaced a minimum of 2 times per day (van Kleef et al., 1994). Ileal digesta was collected continuously for 10 h from 0800 to 1800 h daily (Seneviratne et al., 2010). Collected faeces and digesta were pooled for each pig and period and stored frozen at −20 °C.

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