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Short communication

Nutrient analysis, metabolisable energy and ileal amino acid digestibility of palm kernel meal for broilers

M. Reza Abdollahi[a,*], Brenton Hosking[b], Velmurugu Ravindran[a]

[a] Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Palmerston North 4442, New Zealand
[b] AsiaPac Biotechnology (Dongguan), Dongguan City, Guangdong 523808, China

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ABSTRACT

Nutrient composition, apparent metabolisable energy (AME) and ileal amino acid (AA) digestibility of palm kernel meal (PKM) were evaluated using laboratory analyses and animal studies. The AME assay was conducted with broilers using the classical total excreta collection between d 18 and 25 post-hatch. A maize-soy basal diet was formulated and a test diet, containing PKM, was developed by replacing (w/w) 250 g/kg of the basal diet with PKM. The AME of PKM was calculated based on the difference between the AME values of basal and test diets. Ileal AA digestibility of PKM was determined using two methods, namely direct and difference methods. In the direct method, the assay diet was formulated with the PKM serving as the sole source of AA. In the difference method, the basal and test diets used in the AME assay were used. All diets (both methods) contained titanium dioxide as an indigestible marker. The ratios between the titanium and AA in the diet and digesta were used to calculate the digestibility. The crude protein and fat contents of the PKM sample were 159 and 94.0 g/kg, respectively. The AME and nitrogen-corrected AME of PKM were determined to be 5.47 and 5.23 MJ/kg, respectively. The assay method had no effect ($P > 0.05$) on the ileal digestibility of protein, but influenced ($P < 0.05$–0.001) the digestibility of all AA except tyrosine ($P > 0.05$). Standardised ileal AA digestibility coefficients determined by the difference method were higher than those determined by the direct method. The present data showed that the use of direct method will underestimate the ileal AA digestibility coefficients of feedstuffs with low-protein content.

1. Introduction

Palm kernel meal (PKM), a by-product of the palm oil industry, is produced by extracting the oil from palm kernels using solvent extraction (Sundu et al., 2006). Palm kernel meal is one of the highest quantity of locally available and potentially inexpensive feedstuffs in many tropical countries (Ravindran and Blair, 1992; Perez et al., 2000). However, its inclusion in poultry diets is limited due mainly to its high fibre content, low concentration of indispensable amino acids and grittiness (Sundu et al., 2005, 2006). Moreover, the low contents of crude protein (140–210 g/kg; Nwokolo et al., 1976; Onwudike, 1986;

Abbreviations: AA, amino acid; ADF, acid detergent fibre; AIDC, apparent ileal digestibility coefficient; AME, apparent metabolisable energy; AMEn, nitrogen-corrected AME; DM, dry matter; EAA, endogenous amino acids; GE, gross energy; NDF, neutral detergent fibre; NSP, non-starch polysaccharides; PKM, palm kernel meal; SIDC, standardised ileal digestibility coefficient.

* Corresponding author. Tel.: +64 6 350 5528; fax: +64 6 350 5684.
E-mail address: M.Abdollahi@massey.ac.nz (M. Reza Abdollahi).

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Table 1
Composition of the basal and test diets (g/kg, as fed basis) used in the apparent metabolisable energy (AME) and ileal amino acid (AA) digestibility assays.[a]

Item	AME and ileal AA digestibility (Difference method) assays[b]	Ileal AA digestibility assay (Direct method)
Maize	594.3	–
Palm kernel meal (PKM)	–	945.7
Soybean meal	351.8	–
Soybean oil	17.8	20.0
Dicalcium phosphate	21.7	17.0
Limestone	7.8	13.0
Sodium chloride	2.0	2.0
Sodium bicarbonate	2.3	–
Vitamin–trace mineral premix[c]	2.3	2.3

[a] Titanium dioxide was added (3.0 g/kg) as an indigestible marker in diets used in digestibility assays.
[b] Test diet was developed by replacing (w/w) 250 g/kg of the basal diet by PKM.
[c] Provided per kg diet: Co, 0.3 mg; Cu, 5 mg; Fe, 25 mg; I, 1 mg; Mn, 125 mg; Zn, 60 mg; choline chloride, 638 mg; trans-retinol, 3.33 mg; cholecalciferol, 60 μg; dl-α-tocopheryl acetate, 60 mg; menadione, 4 mg; thiamin, 3.0 mg; riboflavin, 12 mg; niacin, 35 mg; calcium pantothenate, 12.8 mg; pyridoxine, 10 mg; cyanocobalalamin, 0.017 mg; folic acid 5.2 mg; biotin, 0.2 mg; antioxidant, 100 mg; molybdenum, 0.5 mg; selenium, 200 μg.

Sundu et al., 2005) and apparent metabolisable energy (AME; 7.87–11.10 MJ/kg; Sundu et al., 2006; Ezieshi and Olomu, 2007) makes the PKM a less desirable feed ingredient in broiler diets.

Ever-increasing cost of conventional ingredients has motivated poultry nutritionists to explore the use of locally available feed ingredients such as PKM. Despite this interest, only limited studies have been conducted to determine the ileal AA digestibility (Bryden et al., 2009) and AME (Nwokolo et al., 1976; Sundu et al., 2005; Mardhati et al., 2011) of PKM for broilers. The objective of the present study was to assess the chemical composition, AME and standardised ileal AA digestibility of PKM. Two methods of AA digestibility determination, namely the direct method and the difference method, were also compared.

2. Materials and methods

Palm kernel meal, imported from Malaysia, was obtained from a commercial supplier and ground in a hammer mill to pass through a screen size of 3.0 mm to remove any shell fragments. The nutritional evaluation of PKM was carried out in three phases namely, (i) laboratory evaluation, (ii) AME assay and (iii) ileal AA digestibility assay. The experimental procedures for animal trials were approved by the Massey University Animal Ethics Committee and, complied with the New Zealand Code of Practice for the Care and Use of Animals for Scientific Purposes.

2.1. Laboratory evaluation

A representative sample of PKM was analysed, in duplicate, for dry matter (DM), nitrogen (N), crude fat, acid detergent fibre (ADF), neutral detergent fibre (NDF), ash, non-starch polysaccharides (NSP), AA, minerals and heavy metals.

2.2. Apparent metabolisable energy assay

The AME of PKM was determined by the difference method (Nalle et al., 2011). In this method, a maize-soy basal diet was formulated (Table 1) and a test diet, containing PKM, was developed by replacing (w/w) 250 g/kg of the basal diet with PKM.

Day-old male broilers (Ross 308), obtained from a commercial hatchery, were raised in floor pens and fed a commercial broiler starter diet (230 g/kg crude protein) till d 18. Feed and water were available at all times. The temperature was maintained at 32 °C during the first week and gradually decreased to approximately 23 °C by the end of the third week. Central ceiling extraction fans and wall inlet ducts controlled ventilation. On d 18, birds of uniform initial body weight (875 ± 10.2 g) were selected and randomly assigned to experimental cages (six birds per cage) and six replicate cages were randomly assigned to each of the assay diets.

The AME assay was conducted by the classical total excreta collection method. The diets, in mash form, were fed for 7 days (d 18–25), with the first 3 days serving as the adaptation period. During the last 4 days, feed intake was monitored, and the excreta were collected daily, weighed and pooled within a cage. Pooled excreta were mixed well and, representative samples were obtained and freeze-dried. Dried excreta samples were ground to pass through a 0.5-mm sieve and stored in airtight plastic containers at 4 °C for laboratory analyses. The DM, gross energy (GE) and N of the diet and excreta samples were determined.