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Short communication

Effect of fungal fermentation with *Aspergillus niger* and enzyme supplementation on metabolizable energy values of unpeeled cassava root meal for meat-type cockerels

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ABSTRACT

A preliminary in vitro fermentation of unpeeled cassava root meal (UCRM) using *Aspergillus niger* was conducted followed by a force-feeding experiment to investigate the effect of fungal fermentation and enzyme supplementation on metabolizable energy values of UCRM for meat-type cockerels. Thirty two (32) cockerels (Ross 308, 10-week-old) were assigned to four treatment groups consisting of 8 birds per treatment laid out in a 2 × 2 factorial arrangement involving fermented or non-fermented UCRM supplemented with or without commercial enzyme. Additional 8 birds were also used for endogenous study. Compositional analysis of the fermented UCRM showed reduced ($P < 0.05$) dry matter, ash, crude fibre, NDF, ADF, resistant starch, K, Mg, P, increased ($P < 0.05$) hemicellulose and amylopectin content following fungal fermentation with *A. niger*. The concentration of glutamine, glycine and proline in fermented UCRM reduced ($P < 0.05$) while phenyl alanine content increased ($P < 0.05$) following fungal fermentation. Fungal fermentation improved ($P < 0.01$) AME, AMEn, TME and TMEn values of UCRM for cockerels. Enzyme supplementation of fermented UCRM resulted in higher ($P < 0.01$) AME, AMEn, TME and TMEn values than unfermented UCRM. In conclusion, fermentation of UCRM supplemented or not with exogenous enzyme showed prospect for improved metabolizable energy values for cockerels.

Abbreviations: ADF, acid detergent fibre; ADL, acid detergent lignin; AME, apparent metabolizable energy; AMEn, nitrogen corrected apparent metabolizable energy; NDF, neutral detergent fibre; RP-HPLC, reversed phase high performance liquid chromatography; TME, true metabolizable energy; TMEn, nitrogen corrected true metabolizable energy; UCRM, unpeeled cassava root meal.

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1. Introduction

The increasing demand for grains by man and animals coupled with the poor supply and huge cost of conventional cereal grains in developing countries has created a food-feed competition. This scenario stimulated the drive to search for alternative energy sources. Cassava (*Manihot esculenta*) offers a better alternative as a cheap and sustainable energy feedstuff. Cassava root is rich in digestible starch (El-Sharkawy, 2012) supplying approximately 13 times energy/ha yield than maize or guinea corn (Ojewola et al., 2006). Although cassava root has been used to a limited extent as energy feedstuff in poultry nutrition (Eruvbetine et al., 2003; Idowu et al., 2007; Oso et al., 2014), the major limitations to its utilization in poultry ration consist of its constituent low quantity and poor quality protein (Babu and Chatterjee, 1999), presence of cyanogenic glucosides, linamarin and lotaustralin (Banea-Mayambu et al., 1997) and high fibrous content (of its peel).

Solid state fermentation using fungal cultures have been employed to further enrich some local cassava products (Akindahunsi et al., 1999). *Aspergillus niger* posses the capacity to synthesize fibre degrading enzymes (hemicellulases, hydrolases, pectinases), proteases, amylases, lipases, and hydrolyse tannins (Ramirez-Coronel et al., 2003; Villena and Gutierrez-Correa, 2007). Previous studies also confirmed that exogenous enzyme supplementation of erstwhile denigrated feed ingredients improved nutrient digestibility and metabolizable energy values for poultry (Bedford and Schulze, 1998; Cowieson et al., 2003). This study therefore seeks to investigate the effect of fungal fermentation with *A. niger* and exogenous enzyme supplementation on metabolizable energy values of unpeeled cassava root meal for meat-type cockerels.

2. Materials and methods

2.1. Fungal culturing of test ingredient

Freshly harvested cassava root tubers (TMS 30572) were washed, chipped, dried (100–122 g/kg DM) and ground (2.5 mm sieve) to form unpeeled cassava root meal (UCRM). Pure laboratory strain of *A. niger* (Chinese International Centre for Type Culture Collection; CICC, No. 41126) was used for inoculation. Briefly, 200 g UCRM was weighed each into ten (10) conical flasks ($n = 10$), moistened (250 g/kg MC) with nutrient solution (containing analytical grade of 80 g urea, 7 g $MgSO_4 \cdot 2H_2O$, 13 g KH_2PO_4 and 20 g citric acid) and inoculated with 2×10^7 fungal spore per gram of UCRM. Each conical flask was air-sealed and the substrate incubated (30 °C) for 6 days in a bed-packed incubator. At the end of incubation period, fermented UCRM was sterilized (120 °C for 20 min) and used for chemical analysis. All laboratory protocol was done at the Key Laboratory of Agro-ecological Processes in Subtropical Region, Institute of Subtropical Agriculture, Chinese Academy of Sciences, Hunan, China.

2.2. Chemical analysis of samples

Unfermented and fermented UCRM samples ($n = 10$) were analyzed for dry matter (Method 934.01), crude fibre (Method 978.01), ether extract (Method 920.39) ash (Method 942.05) and nitrogen (Method 990.03) using standard methods of Association of Analytical Chemist (AOAC, 2002). Gross energy was estimated using the adiabatic bomb calorimeter (Model 1261; Parr Instrument Co., Moline, IL, USA). The fibre fraction was estimated by the method of Van Soest et al. (1991). Hemicellulose was calculated as the difference between NDF and ADF, while cellulose was calculated as the difference between ADF and ADL. The tannin (Makkar et al., 1993) and cyanide content (De Bruijn, 1971) of samples were determined following standard procedures. The amylopectin content of the samples ($n = 10$) were determined by formation of amylopectin complexes with concanavalin A using commercial kit (Amylose/Amylopectin kit, Megazyme International Co. Ireland). The resistant, non-resistant and total starch content of fermented and unfermented UCRM samples were determined with the aid of a commercial kit (KRSTAR 08/11 Test kit, Megazyme International Co. Ireland) following standard procedure (AOAC, Method 2000.02). The mineral analysis was carried out using ICP–MS (Agilent 7500cx, Agilent Technologies) with appropriate operational conditions. Amino acid analysis was done using the reversed phase high performance liquid chromatography (RP-HPLC) analysis carried out in an Agilent 1100 (Agilent Technologies, Palo Alto, CA, USA) Assembly System.

2.3. Experimental birds, management and design

A total of 40 meat-type cockerels (Ross 308, 12-weeks-old) of average weight 2320 ± 120 g were used in all for this study. There were four treatments laid out in a 2×2 factorial arrangements consisting of non-fermented and fermented cassava root meal supplemented with or without 200 g/kg exogenous enzyme. There were 8 birds assigned to each treatment making a total of 32 birds. The remaining 8 birds were used for endogenous study. Each treatment was replicated eight times with one bird per replicate. Birds were kept in individual iron-type battery cages (each of dimension $35 \times 35 \times 50$; LBH) and fed commercial diets before the commencement of the experiment. The exogenous enzyme used is a multi-enzyme powder containing endo-1,4-β-xylanase (No. EC 3.2.1.8), endo-1,3(4)-β-glucanase (No. EC 3.2.1.6) and cellulases as the main active substances, obtained from a fermentation broth of *Penicillium fumiculosum*. Minimum activities include: 1400 units endo-1,4-β-xylanase and 2000 units endo-1,3(4)-β-glucanase per gram.