

APPARENT METABOLISABLE ENERGY VALUES OF MAIZE OFFAL AS INFLUENCED BY ENZYMES AND COCKTAILS

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ABSTRACT

This study was conducted to quantify the effect of enzymes and cocktail of enzymes on apparent metabolisable energy (AME) value of maize offal to facilitate its inclusion in feed formulation. A completely randomized designed was used in the feeding trial comprising of eight treatments namely T1 (control), T2 (with xylanase), T3 (with multipurpose), T4 (with phytase), T5 (with cocktail of xylanase and multipurpose), T6 (with cocktail of xylanase and phytase), T7 (with cocktail of multipurpose and phytase) and T8 (with cocktail of xylanase, multipurpose and phytase). Each treatment was replicated thrice with one adult cockerel per replicate. The feeding trial was done using the intubation method. Gross energy values for treatments and fecal samples were determined with calorimeter while apparent metabolisable energy values were calculated. Data obtained were subjected to ANOVA using Statistical Analysis System and treatments' means were separated using Duncan Multiple Range Test. Enzymes individually improved the AME value of maize offal compared to the control. The multipurpose enzyme was significantly best ($P < 0.05$) among the three individual enzymes with AME value of 2952.72 Kcal/Kg while phytase was the least (2535.28 Kcal/Kg). The cocktails were significantly different ($P < 0.05$) in their effects on AME of maize offal while treatment T8 gave the significantly highest AME (3649.28 Kcal/Kg) among the treatments. However, there was no significant difference ($P > 0.05$) between treatments T3 and T7. It was concluded that cocktail of enzymes is better than individual enzymes. The AME values obtained are practically useful and have placed enzyme supplemented maize offal as a substitute to conventional energy supplements.

Keywords: Cocktail, Energy, Enzyme, Intubation, Quantification

INTRODUCTION

Maize offal is a by-product of various maize processing industries, including starch and ethanol production, and the production of maize-based foods. While maize bran theoretically consists of the bran coating removed in the early stages of processing, the maize offal sold for livestock feeding is usually a mixture of the bran fraction and other by-products and is, therefore, a very loosely defined product of highly variable composition (Kalscheur *et al.*, 2012). It is also obtained from milling of fermented maize grain using locally fabricated machine which produces the polished grain used for human consumption (Ezieshi and Olomu (2004). It contains the testa, aleurone layer, some quantities of broken endosperm and most of the germ of the maize grain (Vantsawa *et al.*, 2007). Maize offal has 11% CP, 2.1% ether extract and 66.18% nitrogen free extracts (NRC, 1994). However, despite its gross energy (GE) value of 4421.5Kcal/Kg which is similar to that of maize, its poultry metabolisable energy (ME) value is 2325 Kcal/Kg which is just 52% of its GE compare to maize that has 77% of its GE as ME. This is due to the inability of poultry to digest the fibre content of maize offal and release the energy in the complex carbohydrate that makes up the fibre. The exorbitant price of maize especially following the COVID-19 pandemic has forced several poultry farms in Nigeria to fold up thereby exacerbating the existing problem of inadequate intake of animal protein in the country. There is therefore the need for alternative to this energy source.

Exogenous enzymes are added to fibrous feed stuffs to digest the fibre and release the nutrients that are embedded within the fibre. Enzymes have positive effects on maize offal (Jimoh and Atteh, 2018) but the exact quantity of these effects has not been established. This is essential to make provision for the released nutrients so as to make maximum advantage of enzyme inclusion. Furthermore, the need to investigate the effect of enzyme cocktails has been raised based on the fact that enzymes have different profile and activity and it may be impossible for one enzyme to achieve a complete

degradation of the crude fibre components. Therefore, this study was designed to quantify the effects of individual enzymes and cocktails on apparent metabolisable energy value of maize offal.

MATERIALS AND METHODS

Twenty four adult black cockerels of approximately equal weight (about 2.2Kg) were used in this study using completely randomized design. There were eight treatments comprising of one control and seven experimental treatments as shown in Table 1. Three exogenous enzymes namely xylanase, multipurpose and phytase were used according to the manufacturers' recommended inclusion level of 100 ppm, 150 ppm and 150 ppm respectively for Xylanase enzyme, multipurpose enzyme and phytase enzyme. The study was conducted at the University of Ilorin.

Table 1: Composition of Experimental Treatments

Test Material	Treatments							
	T1	T2	T3	T4	T5	T6	T7	T8
Maize offal (%)	100	100	100	100	100	100	100	100
Xy ¹ (ppm)	--	100	--	--	100	100	--	100
Mp ² (ppm)	--	--	150	--	150	--	150	150
Ph ³ (ppm)	--	--	--	150	--	150	150	150
Analysis								
CP (%)	11	11	11	11	11	11	11	11
ME (Kcal/Kg)	2377	2377	2377	2377	2377	2377	2377	2377

1: Xylanase enzyme 2: Multipurpose enzyme 3: Phytase enzyme. T1= No enzyme, T2=Xylanase enzyme alone, T3=Multipurpose enzyme alone, T4=Phytase enzyme alone, T5=Cocktail of Xylanase and Multipurpose, T6=Cocktail of Xylanase and Phytase, T7=Cocktail of Multipurpose and Phytase, T8 =Cocktail of Xylanase, Multipurpose and Phytase

Twenty four (24) adult black cockerels were randomly allocated to the battery cage with one bird in a cell representing a replicate. The birds were provided with *ad libitum* feed and water before the supply of experimental diet. The feeding trial was done using the intubation method as described by Sibald (1976) with some modifications. Gross energy values of the maize offal and the fecal samples were determined using bomb calorimeter (Gallenkamp Ballistic Bomb calorimeter). Apparent metabolisable energy value for each treatment was calculated. The general linear procedure of Statistical Analyses System (SAS, 2002) was used to analyze the data while significant differences between treatments' means were separated using Duncan Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Effects of enzymes and cocktails on AME of maize offal are shown in Table 2. The AME was significantly highest ($P < 0.05$) for the multipurpose enzyme among the three individual enzymes while phytase gave the least effect on AME of maize offal. Addition of enzymes is known to improve the digestibility of maize offal (Milad *et al.*, 2011; Jimoh and Atteh, 2018). However, Animal Nutritionists, Researchers and livestock farmers have continued to use the same table value for maize offal when supplemented with enzyme even when it is apparent that there will be improvement in the nutritive value. This is due to the absence of enhanced nutritional value due to enzyme addition. This value is essential so as to maximize the effects of the addition of enzymes on maize offal. Aletor (1999) observed that cereal offal is known to be of high fibre content which reduces the nutrient utilization and cause metabolic dysfunction in monogastric animals. With the addition of exogenous enzymes which can break down fibre, the utilization of these nutrients would be enhanced. The degree of enhancement will however depend on the type of enzyme involved. This may be responsible for the difference in the AME values among the three individual enzymes as obtained in this study. The positive effect of phytase on AME observed in this study may be attributed to 'extra phosphoric' effect as it is originally designed for phytate.

The AME of treatment T8 (cocktail of the three enzymes) is significantly highest (3649.28 Kcal/Kg) among the treatments. Three of the cocktails (T5, T6 and T8) are significantly better ($P < 0.05$) than their respective individual enzymes (T2, T3 and T4) while cocktail of multipurpose enzyme and phytase (T7) was not significantly different from the multipurpose enzyme (T3) although it was

significantly better than phytase (T4). These AME values for the cocktails are indications of the synergistic effects of the enzymes' combination. Synergistic effect of enzymes may be attributed to several reasons and these include the presence of endo- and –exo- acting enzymes, the difference in activity of the enzymes (enzyme unit per gram) as well as the presence of the respective substrate. When an enzyme's active sites are exhausted, the presence of another enzyme with similar activity and more active sites would increase the overall digestibility of the substrate. For instance the multipurpose enzyme has 18,000,000 units of xylanase per gram of the enzyme complex compared to 9,000 units for the xylanase enzyme used (as stated by the manufacturers). The multipurpose enzyme also has other enzyme activities like glucanase, hemicellulase and cellulase among others. This explains why treatment T5 is significantly better than treatment T3 (multipurpose enzyme) alone and treatment T2 (xylanase) alone. This treatment also resulted in highest percentage increase in AME with 53.46% compared to others while phytase gave the least of 6.62% increase in AME.

Table 2: Effects of Enzymes and Cocktails on Apparent Metabolisable Energy Value of Maize Offal

Parameters	Treatments								SEM
	T1	T2	T3	T4	T5	T6	T7	T8	
AME, Kcal/Kg	2377.94 ^g	2688.28 ^e	2952.72 ^c	2535.28 ^f	3316.61 ^b	2785.27 ^d	2993.69 ^c	3649.28 ^a	82.42
AME Increment, %	0.00 ^g	13.05 ^e	24.17 ^c	6.62 ^f	39.47 ^b	17.13 ^d	25.89 ^c	53.46 ^a	3.46

a, b, c, d, e, f, g: means in the same row with same superscript are not significantly different (P>0.05)

AME=Apparent metabolisable energy, T1= No enzyme, T2=Xylanase enzyme alone, T3=Multipurpose enzyme alone, T4=Phytase enzyme alone, T5=Cocktail of Xylanase and Multipurpose, T6=Cocktail of Xylanase and Phytase, T7=Cocktail of Multipurpose and Phytase, T8 =Cocktail of Xylanase, Multipurpose and Phytase

The increment in AME value of maize offal due to phytase enzyme in this study (6.62%) corroborates the findings of other researchers like Ravindran *et al.* (2000) who reported that phytase increased the AME value of broiler diet by 5.34%. This effect of phytase on AME could be attributed to the complex nature of the chelate (phytate) as its breakdown will result in the release of other nutrients thereby making them available for digestive enzymes. Moreover, McCleary (2001) reported that most enzyme complexes have traces of other side chain enzyme activity other than the main activity for which it is labeled. Thus, there could be traces of carbohydrase, protease or lipase in the phytase enzyme.

CONCLUSION AND RECOMMENDATION

Quantifying the effects produced by enzymes is essential to ensure that feed formulation is done with precision when enzymes are added to the feed. It also helps to maximize the advantage of enzyme supplementation. The results of this study have also buttressed the need for cocktail of enzymes. The AME values obtained in this study are practically useful when the respective enzymes are available.

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