Effect of Mannanases-predigested Palm Kernel Meal in the Diets on Nutrient Digestibilities and Broiler Performance

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Abstract

Two studies were conducted to determine the efficacy of using mannanase treated and untreated palm kernel meal (PKM) with different commercial mannanases in various broiler diets. Forty five birds and 160 birds were used for digestibility and performance studies respectively. Three different diets (PKM with no enzyme and PKM pretreated with mannanase A or B) were offered to the birds for digestibility study. In contrast, 7 different diets containing 0% PKM as control (T1), 10% PKM (T2), 10% mannanase A-treated PKM (T3), 10% mannanase B-treated (T4) were offered for performance study. The pre-treated PKM was heated in the oven at 90oC for 15 minutes to inactivate the enzyme prior to its mixing with the diets. The study was conducted for 42 days and the birds were fed their respective diets ad libitum. Faecal discharge was collected for three consecutive days for faecal coefficient of digestibility and ileal digesta was taken from Mackel's diverticulum to 1 cm before caeca for ileal amino acid digestibility. Data indicated that pre-digested PKM with both mannanases increased digestibility of crude fibre and AME of PKM (P<0,05). However, an increased ileal protein digestibility and a decreased moisture content of faeces were only found in birds fed the mannanase A treated PKM. Addition of 10% PKM in the broiler diet negatively affected body weights of birds when compared with the birds fed the control diet (T1). Predigestion of PKM with mannanase A improved feed intake and body weight gain significantly. In conclusion, Predigested PKM with mannanase could be effectively used to improve the nutritive value of PKM.

Key words: mannanase, palm kernel meal, predigestion and broiler

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Introduction

Palm kernel meal (PKM) as an agricultural by-product is produced abundantly in Indonesia. Since 2008, Indonesia has been the world's biggest producer of palm kernel meal (FAO, 2008), being about 2.04 million tonnes/year. Although palm kernel meal appears to have favourable nutrients for growing chickens, nutrient qualities are poor due to high fibre content, particularly mannan, and low digestibility (Sundu *et al*., 2008). Accordingly, the use of this by-product in poultry diet is limited.

Treatment of low quality feedstuffs with exogenous enzymes has been a focus of research in animal feed industry. Conventional use of an enzyme through its direct application onto the diet may inactivate the enzyme when the enzyme containing diet was pelleted due to its heat exposure (Sundu *et al*., 2006). Instead of using conventional method of enzyme application onto the diet, predigestion was used to cope with the problem of enzyme damage due to pelleting. Predigestion is an enzymatic treatment taking place in a chamber. Setting up the temperature and moisture during treatment process have been an important procedure to be considered. Two studies were conducted to determine the effect of predigestion using mannanase in palm kernel meal based diets.

Materials and Methods

Animals and Diets

Forty five birds and 160 birds were used for digestibility (experiment 1) and performance studies (experiment 2) respectively. Three different diets (PKM with no enzyme and PKM pretreated with mannanase A with the activity of 800 U/g or mannanase B with the activity of 1100 U/g) were offered to the birds for digestibility study. Due to commercial reason, the brands of these two enzyme products were confidential. Palm kernel meal and pre-digested palm kernel meal being used in these two studies were kindly provided by Wilmar Company. Prior to mixing with other feed ingredients and feed additives, the pre-digested palm kernel meal were heated in the oven at 90^{o}C for 15 minutes to inactivate the added enzymes in the diet.

In experiment 2, 7 different diets containing 0% PKM as control (T1), 10% PKM (T2), 10% mannanase A-treated PKM (T3), 10% mannanase B-treated (T4)

Table 1. Ingredient composition of experimental diets (g/kg)

Diet 1 (D1)	Diet 2 (D2)	Diet 3 (D3)	Composition
Untreated PKM	Mannanase A- PKM	Mannanase B- PKM	915
Palm oil	Palm oil	Palm oil	40
Limestone	Limestone	Limestone	16
Salt	Salt	Salt	5
Premix	Premix	Premix	4
Celite	Celite	Celite	20

Table 2. Experimental diets composition (g/kg)

Feed Ingredients	Starter Diets				Grower Diets			
	T1	T2	T3	T4	T1	T2	T3	T4
Palm kernel meal	0	100	100	100	0	100	100	100
Maize	512	460	460	460	560	470	470	470
Full fat soybean	250	250	250	250	250	250	250	250
Fish meal	130	130	130	130	100	100	100	100
Rice bran	86	42	42	42	70	58	58	58
Palm oil	0	0	0	0	0	5	5	5
Dicalcium phosphate	16	12	12	12	14	11	11	11
Premix	2	2	2	2	2	2	2	2
DL- methionine	2	2	2	2	2	2	2	2
L-Lysine	1	1	1	1	1	1	1	1
Salt	1	1	1	1	1	1	1	1
Calculated:								
AME (MJ/kg)	12.97	12.85	12.85	12.85	13.19	13.02	13.02	13.02
Protein	228	229	229	229	212	214	214	214
Methionine	6.0	5.9	5.9	5.9	5.7	5.7	5.7	5.7
Cysteine	3.7	3.7	3.7	3.7	3.5	3.6	3.6	3.6
Lysine	12.8	12.8	12.8	12.8	12.7	12.7	12.7	12.7
Calcium	11.8	11.7	11.7	11.7	10.5	10.1	10.1	10.1
Phosphorous	8.7	8.6	8.6	8.6	8.4	8.2	8.2	8.2

were offered for performance study. The pre-treated PKM was heated in the oven at 90 ^{o}C for 15 minutes to inactivate the enzyme prior to its mixing with the diets. The study was conducted for 42 days and the birds were fed their respective diets *ad libitum*. Faecal discharge was collected for three consecutive days for faecal digestibility and ileal digesta was taken from Mackel's diverticulum to 1 cm before caeca for ileal protein digestibility.

Statistical analysis

A completely randomized design was used in each of these two experiments. Three treatment diets with five replicate cages and four different diets with five replications were used for trial 1 and trial 2 respectively. Data were analyzed by analysis of variance using Minitab software package. Differences among treatments were tested for significance by using Tukey Test (Steel and Torrie, 1980).

Results and Discussions

Data of effect of predigestion on nutrient digestibilities and broiler performance are shown in Tables 3 and 4. It has been well recognized that most of the dietary fibre in PKM is in the form of indigestible mannan (Daud and Jarvis, 1992). Efficacy of using an enzyme to increase feed digestibility has been long recognised by nutrisionists in various feedstuffs. However, all the data of the efficacy of enzyme were based on direct addition of enzyme onto the diet. Direct application of enzyme suffers from enzyme damage when the diet was pelleted due to heat exposure. Accordingly, predigestion where the low quality feedstuffs undergo degradation process in the digestion chamber prior to mixing the diet, was able to minimise the inacticity of enzyme during pelleting or feed production.

The AME of PKM in this present study was low, being 6.0 MJ/kg. Treatment with mannanase increased AME of PKM by 24 to 27%. This improvement may partly be due to an increased digestibility of crude fibre when PKM was treated with mannanase. Even though the activity of the mannanases used in this current study was different, digestibilities and AME of the PKM were statistically the same between two mannanase-treated PKMs in experiment 1. It can be speculated here

Table 3. Effect of predigestion on nutrient digestibilities in experiment 1

Parameters	D1	D2	D3	SEM
Dry matter digestibility (%)	36.7[a]	42.4[b]	41.1[ab]	1.7
Crude Fibre digestibility (%)	17.2[b]	27.4[a]	29.3a	3.0
Faecal protein digestibility (%)	52.0	58.0	54.5	2.1
Ileal protein digestibility (%)	52.1[b]	58.3[a]	54.9[b]	0.8
Apparent Metabolizable Energy (MJ/kg)	6.00[b]	7.61[a]	7.43[a]	0.43
Faecal moisture (%)	72.2	71.4	71.9	0.8

Note: Values with the different superscript within a column are significantly different ($P<0.05$).

Table 4. Effect of predigestion of PKM with mannanase on body weight gain, feed intake and FCR in experiment 2

Parameters	T1	T2	T3	T4	SEM
Body weight gain (g)	2009[ab]	1865[b]	2083[a]	1988[ab]	21.6
Feed intake (g)	3615[a]	3417[b]	3692[a]	3659[a]	28.2
FCR	1.80	1.83	1.78	1.84	0.01

Note: Values with the different superscript within a column are significantly different ($P<0.05$).

that the mannanase A activity of 800 U/g may be enough to optimally increase digestibilities and AME of this enzyme treated PKM. Further increased activity of 1100 U/g for mannanase B did not affect feed digestibility and AME of PKM greater than that for mannanse A.

Although the digestibility of protein either by using the total faecal collection or the illeal digesta method was nearly the same, coefficience of variance of faecal protein digestibility tended to be higher than those of illeal protein digestibility (8.5 vs 5.8%). It can be said here that problem of measuring protein digestibility in the faeces was not only as a matter of contaminated faecal protein with urine and the microbes outflow from the large intestine, but also this procedure sufferred from high variance of the data. It is possible that high coefficience of variance of faecal protein digestibility found in this current study was partly due to variation in total amount of microbe and urine outflow to the faeces and this may not be found in illeal digesta.

Addition of 10% PKM in the broiler diet did not negatively affect the body weight of birds, compared to the birds fed the control diet. These data are consistent with the results reported by Panigrahi and Powell (1991). The data also clearly suggest that the use of 10% PKM in the broiler diet could be promoted in PKM producing countries where the PKM was abundantly available. There was a trend that treating PKM with mannanase slightly increased bodyweight gain but this improvement was not statistically significant. The efficacy of this enzyme treatment technology become evident when the birds were fed on the 10% PKM in the diet. In this particular diet, treatment of PKM with mannanase A improved body weight gain significantly and the body weight of birds fed a mannanase A-treated 10% PKM in the diet exceed the body weight of birds fed the control diet (2009g vs 2083 g). In conclusion, this enzyme treatment technology can be effectively used to increase feed digestibility and AME of PKM and improved body weight gain, particularly within the inclusion rate of 10% PKM in the broiler diet.

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