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The efficacy of multy-enzymes supplementation on low energy corn-soybean meal basal diet containing rice bran on growth performance of broilers

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ABSTRACT

High energy diet is related to high feed cost. Thus, it is essential to reduce energy diet but still support the good performance of birds. The utilization of low cost- feed ingredients combined with enzymes are the alternative way to do. The objective of this study was to investigate the effects of multy-enzyme supplementation on growth performance of broilers fed low energy basal diets containing rice bran. Experiment 1. The apparent metabolizable energy (AME) assay of yellow corn and rice bran. A total of 48 broilers were randomly distributed to 12 cages (4 birds/cage). A maize-soybean meal basal diet (mash form) was formulated and two assay diets were then developed by substituting rice bran (raw 250 g kg-1, w/w) and maize (500 g kg-1, w/w) of the basal diet. Total excreta collection method was used. The results showed that the AME value of rice bran was significantly lower (2032 kcal/kg DM) and 3112 Kcal/kg DM. Experiment II. The experiment was designed using a completely randomized design with four treatments and six replications. A total of 160 DOC (unsex) were randomly distributed to 16 pens (10 birds/pen). The experimental diets were iso-nitrogenous and iso-energetics. The results show that dietary treatments significantly affected (P<0.05 to 0.01) body weight gain (BWG), and feed intake (FI), but it did not affect (P>0.05) FCR and mortality of broilers. Broilers fed P2, P3 and P4 diets had higher (P<0.05) growth performance than that of P1. The growth performance of broilers in P2, P3 and P4 treatments were similar (P>0.05). In conclusion, 1) the supplementation of enzymes in low energy diets containing rice bran improved BWG and FI but not FCR and mortality. 2) Birds fed rice bran-containing-diets supplemented with enzymes produced similar growth performance.

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Keywords:
Broilers; low energy diets; rice bran; enzymes; growth performance

1. Introduction

Broilers are known as type of birds that require high amount of nutrients including energy in their diets. The low energy level will impair their production performance. However, the high level of energy will result in high feed cost and high production cost. Poultry feed industry, and animal farmers try to modify broiler feed by using non-conventional feedstuff such as putak (sago) (Nalle *et al.,* 2017) and rice bran or by supplementing enzymes in broiler diets. Rice bran contains high energy but it has antinutrients such as fiber phytic acid (Kaur *et al.,* 2011). The soluble fibre content of rice bran was 2.28-3.15%, insoluble fibre 16.49-23.36%, and total dietary fibre 18.77-42.62%, the phytic acid content of rice bran was 5.05-8.48% (Garcia *et al.,* 2012; Kaur *et al.,* 2011). According to Medugu *et al.* (2011) the maximum inclusion level of rice bran was 10%, 20% and 25% in broiler starter, finisher and layer diets, respectively.

The high fibre content in broiler diets has been reported to lower nutrient digestibility, growth performance, increasing digesta viscosity and wet litter (Krás *et al.,* 2013; Liu *et al.,* 2011, Silva *et al.,* 2013, Sadegi *et al.,* 2015). On the other hand, Mateos *et al.* (2012) explained that feeding broiler chickens with moderate level of fibre might improve development of digestive organ, production of digestive enzyme, and growth performance. Relating with phytic acid, Adeola and Cowieson (2011) reported that phytic acid reduced P availability in broilers due to unbreakable 6 phosphate binding.. Reddy (2001) reported that the majority of P in rice bran (64-85.7%) is phytic acid. According to Garcia et al. (2012) the range of phytic phosphorus in rice bran was from 14.3 to 23.8 g/kg. Based on these explanations, the research the effect of supplementation of enzymes on low energy basal diets containing rice bran had been conducted. The aim of this research was to evaluate the growth performance of broilers fed low energy basal diets containing rice bran and supplemented with enzymes.

2. Materials and Methods

2.1. Experiment I. Apparent metabolizable energy assay

Birds. Total of 48 unsex growing broilers used in this study.

Feedstuffs. Rice bran and yellow corn were obtained from local distributor. Corn were ground using hammer mill to pass through 3 mm sieve prior to use.

Assay diets. A yellow corn-soybean meal basal diet was formulated and two assay diets were then made by substituting rice bran (250 g kg^{-1} w/w), and yellow corn (500 g kg^{-1} w/w) of the basal diet (Table 1 and Table 2).

AME assay procedure. A total of 48 unsex growing broilers (21 day of age) were selected and randomly distributed to 12 experimental unit (4 birds per unit). The birds were given a commercial broiler diet (180 g kg^{-1} crude protein) until the implementation of treatment diets on day 28. Feed and water are freely available for 24 hours. The classical total excreta collection method was used for the AME determination. For each treatment, feed intake and excreta were collected from day 32 to day 35. The excreta were then mixed, sub sampled, and oven dried (60 ^{o}C) for two days. The dried excreta, diets and test ingredients were ground (0.5-mm sieve) and stored in sealed plastic bag for the determination of dry matter, gross energy and nitrogen contents.

Chemical Analysis

The dry matter content was determined by using AOAC method method no. 930.15 (2005). PARR 1341 Plain Oxygen Bomb Calorimeter was used to measure gross energy level. Nitrogen content was determined using Kjeldahl method, whereas HPLC was used to determine the amino acid contents.

Calculations

The calculation of AME value of the assay diets and ingredient using the following formula:

$$AME_{diet}\ (MJ/kg) = \frac{(\text{feed intake} \times GE_{diet}) - (\text{excreta output} \times GE_{excreta})}{\text{Total feed intake}}$$

$$AME_{rice\ bran}\ (MJ/kg) = \frac{\text{AME of rice bran diet} - (\text{AME basal diet} \times 0.75)}{0.25}$$

$$AME_{yellow\ corn}\ (MJ/kg) = \frac{\text{AME of yellow corn diet} - (\text{AME basal diet} \times 0.50)}{0.50}$$

Factor of 36.54 kJ/g N retained in the body was used to calculate zero nitrogen retention (Hill and Anderson, 1958).

Table 1. Diets for AME assay. Experiment 1

Diets	Treatments	
A	Basal diet (maize-soybean meal)	
B	Basal diet (maize-soybean meal)	+ 25% rice bran
C	Basal diet (maize-soybean meal)	+ 50% yellow corn

Table 2. Composition of Basal diet (g/kg air dry basis)

Ingredient	
Maize	594.6
Soybean meal	351.8
Vegetable oil	17.8
Dicalcium phosphate	21.7
Limestone	7.8
Salt	2.0
Sodium bicarbonate	2.3
Vitamin-Mineral Premix*	3.0

* Sanmix, PT Sanbe Farma, per kg provided:Vit A (1250000IU), Vit D3 (250000IU), Vit E (750 IU), Vit K (200 mg), Vit B1 (150 mg), Vit B2 (500 mg), Vit B6 (500 mg), Vit B12 (1012 mcg), Vit C (3000 mg), Ca-d-pantothenate (500 mg), Niacin (3500 mg); methionine (3500 mg), Lysine (3500 mg), Manganese (10000 mg), Iron (2500 mg); Iodine (20 mg), Zn (10000 mg), Cobalt (20 mg), Copper (300 mg), Antioxidant (1000 mg).

2.2. Experiment II. Feeding value of low energy diets containing rice bran and supplementing with multy enzymes

Birds, feedstuff, and enzymes. DOC broilers (CP 707, unsex) were obtained from local hatchery. Rice bran and yellow corn used in this study was from local supplier. Enzymes used were Phyzyme and Avizyme 1502. Both enzymes were the brand products of Danisco Animal Nutrition. Phytase contains phytase derived from E. coli strain, while Avizyme 1502 contains xylanase, amylase and protease.

Treatment diets. The experimental diets (Table 2) containing different energy level and supplementing with single (Avizyme or Phyzyme) or combined enzymes (Avisyme and Phyzyme) were formulated using the nutritional composition of yellow corn and rice bran obtained in Experiment I. The nutrient requirement of experimental diets was based on Indonesian National Standard (SNI, 2006).

Methodology.
The experimental design was completely randomized design with four treatments and six replications. The treatments were P1 (basal diet), P2 (low energy basal diet containing rice bran + Phyzyme), P3 (low energy basal diet containing rice bran + Avizyme), and P4 (low energy basal diet containing rice bran + Phyzyme + Avizyme).

Table 3. Treatment diets

Feed Ingredient	**Treatment (g/kg)**			
	P1	**P2**	**P3**	**P4**
Yellow corn	534.9	456.7	456.4	456.2
Rice bran	0.00	95.0	95.0	95.0
Soybean meal	297.6	266.2	266.2	266.2
Meat and bone meal	50.0	56.0	56.0	56.0
Fish meal (CP 39%)	50.0	51.3	51.3	51.3
Vegetable oil	44,5	56,0	56,0	56,0
DL-Methionine 99%	2.00	2.20	2.20	2.20
L-Lysine HCl, 99%	0.10	0.50	0.50	0.50
Limestone	9.00	0.50	0.50	0.50
Dicalcium phosphatee	6.00	0.50	0.50	0.50
Salt	2.50	2.50	2.50	2.50
Sodium bicarbonate	0.40	0.40	0.40	0.40
Vitamin-Mineral Premix*)	3.00	3.00	3.00	3.00
Phyzyme	0	0.20	0	0.20
Avyzyme	0	0	0.50	0,50
Jumlah	**1,000**	**1,000**	**1,000**	**1,000**
Calculated composition				
AME (Kcal/kg)	3,103	3,088	3,087	3,086
Crude Protein (g/kg)	224	215	215	215
Lysine (g/kg)	12.5	12.0	12.0	12.0
Met + Cys (g/kg)	9.80	9.55	9.55	9.55
Ca (g/kg)	10.3	10.3	10.3	10.3
Av P (g/kg)	4.6	4.5	4.5	4.5

*) Sanmix, PT Sanbe Farma, per kg provided:Vit A (1250000IU), Vit D3 (250000IU), Vit E (750 IU), Vit K (200 mg), Vit B1 (150 mg), Vit B2 (500 mg), Vit B6 (500 mg), Vit B12 (1012 mcg), Vit C (3000 mg), Ca-d-pantothenate (500 mg), Niacin (3500 mg); methionine (3500 mg), Lysine (3500 mg), Manganese (10000 mg), Iron (2500 mg); Iodine (20 mg), Zn (10000 mg), Cobalt (20 mg), Copper (300 mg), Antioxidant (1000 mg).

A total of 160 broiler chicks were randomly distributed to 16 experimental pens (10 birds/pen). Feed in mash form and water are freely available for 24 hours during 21-day experiment. Temperature and humidity were controlled by using thermo-hygrometer. During the first week the temperature ranged between 31-33^{0}C. and decrease to 24^{0}C.

Measurements: Body weight, feed intake and mortality were recorded weekly during the experiment. Feed per gain values were corrected for the body weights of birds that died during the experiment.

Statistic analysis. The pen means were used to derive performance data. All data were analyzed using GLM Procedure of SAS version 9.1 (SAS Institute, Cary, NC, USA). Differences between treatments were calculated to be significant at $P<0.05$. Significant differences among the treatments were calculated using Fisher's Least Significant Difference Test.

3. Results and Discussion

3.1. Experiment I. Nutrient characterisation of rice bran and yellow corn used for second experiment

As can be seen form Table 4, the nutritional composition of yellow corn was better than rice bran. The fibre content of rice bran was higher (314,8 g/kg DM) than that of yellow corn (22,9 g/kg DM).

Table 4. Proximate, fibre, minerals (g/kg DM), and gross energy (kcal/kg) of rice bran and yellow corn

	Rice bran	Yellow corn
Dry matter	897.5	883.1
Crude protein	74.1	91.7
Crude fat	44.2	14.4
Crude fibre	314.8	22.9
NFE	305.8	736.9
ADF	430.9	165.6
NDF	616.8	365.3
Mineral	158.6	17.2
Ca	15.3	11.5
P	6.4	5.5
Gross energy	3693	3763

[1] each value is the average of 2 replicates

Table 5 shows the amino acid concentration of yellow corn and rice bran. The difference in amino acid content between yellow corn and rice bran reflected the difference in crude protein content of sample. Corn lysine was slightly higher (1,0 g/kg) than rice bran (0.9 g/kg). Methionine content of rice bran was slightly higher (0,9 g/kg) than that of yellow corn (0,8 g/kg).

Table 5. Amino acid concentration (g/kg) of yellow corn and rice bran

Amino acid	Rice bran	Corn
Indispensable		
Arginine	2.0	1.6
Histidine	1,0	0.9
Isoleusine	0.9	1.2
Leusine	1.0	0.6
Lysine	0.9	1.0
Methionine	0.9	0.8
Phenilalanine	2.4	1.8
Threonine	1.1	1.1
Valine	2.9	2.1
Dispensable		
Alanine	2.6	3.2
Aspartic acid	4.6	5.0
Cystine	0.8	0.7
Glysine	1.4	1.3
Glutamic acid	11.8	1.2
Proline	1.5	3.9
Serine	5.4	1.7
Tyrosine	1.6	1.2

[1]each value is the average of 2 replicates

Table 6 represents the AME and nitrogen correction of AME (AMEn) values of yellow corn and rice bran. The AME/n values of rice bran sample evaluated was significantly (P<0.05) lower than the AME/n values of yellow corn. The lower AME/n values of rice bran was due to the high fibre content (Table 4). It well established that dietary fibre causes high digesta viscosity leading to decrease nutrient digestibility. The decrease in nutrient digestibility will result in low nutrient absorption including energy absorption and availability to animals (Mateos et al., 2012; Silva et al., 2013; Krás et al., 2013; Liu et al., 2011).

Table 6. The apparent metabolisable energy (AME/n) (kcal/kg DM) of rice bran and yellow corn[1)]

	Rice bran	Yellow corn
AME	2032^{b}	3142^{a}
AMEn	1908^{b}	2919^{a}

[1] each value is the average of 4 replicates
(4 birds/replicate)

The correction for N equilibrium decreased the AME value of rice bran from 2032 Kcal/kg DM to 1908 kcal/kg DM. The AME/n values obtained in the present study were lowered than the AME/n values of rice bran investigated by Attia et al. (2002) which were 2882.34 kcal/kg DM (AME) and 2612.27 (kcal.kg DM (AMEn). These differences were probably due to its fat content, fibre content, age of birds used, and the inclusion level of rice bran used for AME assay.

3.2. Experiment II. Feeding value

Table 7. shows the growth performance of broilers fed low energy basal diets containing rice bran supplemented single or combination of enzymes. As can be seen from the Table 7., supplementation of phyzyme, avizyme or combination between avizyme and phyzyme significantly (P<0.05) improved body weight gain and feed intake of broilers but it did not affect (P>0.05) the feed per gain and mortality rate of broilers during 21 day of experiment. No significant differences (P>0.05) were observed in all investigated parameters among treatment diets supplemented with enzymes.

The results were in good agreement with Attia *e*t al. (2002) who found an improvement in body weight gain of broilers fed rice-bran-containing-diets supplemented with phytase and other enzymes. However, Attia et al (2002) also found that the FCR of broilers fed rice bran-containing-diets increased by the supplementation of phytase and other enzymes. The differences were probably caused by factors such as the activities of phytase, other enzymes used in the experiment's energy level of diets.

Table 7. The supplementation effects of enzymes in low energy diets containing rice bran of growth performance of broilers

Treatment	BWG (g/bird)	FI (g/bird)	FCR (g/g)	Mortality (%)
P1	472^{b}	798^{c}	1.794	2.5
P2	583^{a}	913^{a}	1.579	0.0
P3	609^{a}	988^{a}	1.683	5.0
P4	602^{a}	876^{bc}	1.642	0.0
Probability, P<	**	**	NS	NS

^{a,b} Means of column with the superscripts significant difference (P<0.05), *: Significant (P < 0.05); **: significant (P < 0.01); NS: Not significant (P>0.05)

[1]each value is the average of 4 replicates (10 birds/replicate)

Even though no significant differences were observed in FCR among all treatments, numerically the FCR of broilers given rice bran-containing-basal diets supplemented with enzymes were lower (1.579-1.683) than that of control diet (1.794). The lower FCR in P2, P3, P4 treatments might be due to the improvement of nutrient digestibility leading to more nutrients available to the birds. Phytase (phyzyme) which hydrolysed phytic acid will release phosphor, while avizyme improved the digestibility of starch, protein and fibre of the diets.

4. Conclusions

The supplementation of enzymes either in single or combination in low energy broiler diets improve body weight gain and feed intake, but it did not change the feed efficiency and mortality rate of broilers during the experiment. Rice bran-containing-basal diets supplemented with avizyme, phyzyme or combination between avizyme and phyzyme produced similar body weight gain, feed intake, FCR and mortality rate.

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