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THE EFFECTS OF RICE BRAN FERMENTED WITH *Aspergillus niger* ON QUALITY OF PIG PRODUCT TO ENSURE FOOD SECURITY

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Abstract

In Indonesia rice bran as agricultural waste available abundantly and as major component in pig ration. The limited factor of this material has a high content of phytic acid, inhibitor of phosphorus metabolism. The objectives of this research was to study the effects of rice bran fermented with Aspergillus niger fungus on back fat thickness, meat cholesterol content, bone hardness degree and feed efficiency. Thirty-two castrated pig crossbred Spoted Poland China and Chester White, at12-week-old with live weight of between 32-44 Kg, put in individual cages. The treatments were R1 = 40% rice bran nonfermented, R2 = 40% rice bran fermented 2 days, R3 = 40% rice bran fermented 4 days, R4 = 40% rice bran fermented 6 days. Treatment was given to 4 groups of pigs with different body weight each B1 = 32 kg; B2 = 36 kg; B3 = 40 kg; B4 = 44 kg. The experimental design used was Randomized Block Design. The results shows that utilization of fermented rice bran along 6 days (R4) has back fat thick and meat cholesterol content significant (P<0,05) lower than the other treatments. On the other hand treatment R4 has bone hardness and feed efficiency significant better (P<0.05) compared to the other treatments. The conclusion was utilization of 40% of rice bran fermented along 6 days with Aspergillus niger were able to improved feed efficiency and quality product of pig meat for human health.

Key words *: rice bran, A.niger, pig, quality.*

INTRODUCTION

Indonesian rice production were surplus in 2016/2017 around 82,2 million ton and from that amount approximately 60% was rend amen of endosperm, rice bran content around 11% or equivalent to 6.3 million ton of rice bran production. It is common used rice bran in pig fattening ration around 60-80% (Awuy, 2011) which is produced meat with pale in color.

It was reported the pig is able to utilized only around 15% of rice bran phosphorus content (Cromwel et al, 1993; Wahyuni., 2003) due to the presence of phytate (Woyengo et al., 2013). Phytic acid is the primary phosphate storage compound in seeds, typically contributing 50-80% of total phosphate in plant seeds.

The salt form of phytic acid is called phytate, and almost all phytic acid is present as a mixed salt (phytin). Phytate P is poorly available to animals and can reduce the digestibility of other nutrients and the performance of animals owing to its anti nutritional effect (Woyengo et al., 2013).

Phytate also non-selectively binds (Despande et al., 1984) to proteins and has been shown to inhibit enzymes including trypsin and α-amylase, thus reducing protein digestibility in animals Microbial phytase is the most commonly used exogenous enzyme in the feed for monogastric animals.

Phytase can reduce the anti nutritional effect of phytate and improve the digestibility of phosphorous (P), calcium, amino acids and energy, as well as reduce the negative impact of inorganic P excretion to the environment. Phytase (myo-inositol hexa bisphosphate phosphohydrolase) catalyzes the stepwise removal of phosphate from phytic acid or its salt phytate (Wyss et al., 1999; Yu et al., 2012). Phytase activity is measured as a phytase unit. In the official standardized phytase activity measurement, 1 unit is the amount of phytase that liberates 1 mmol of inorganic phosphate per minute from 0.0051 mol L^{-1} sodium phytate at pH 5.5 and at a temperature of 37°C (AOAC, 2000). Phosphorus content in rice bran is about 1.44%, but 89% is unavailable P in

form phytate-bound P as inositol Phosphat-6. In broilers and laying hens, it was observed that the rate of hydrolysis of IP6 and total P retention differed significantly between feed ingredients. Weaning piglets fed with a diet corn–SBM registered a decreasing Ca:P ratio from 1.8 to 1.2, which improved body weight gain and feed efficiency (Leske et al., 1999; Adeola et al. 2006).

Increasing dietary Ca: available-P ratio in the absence of phytase reduced bone ash, but in the presence of phytase bone ash was increased (Amerah et al, 2014; Selle et al., 2009). The objective of this research was to study the effects of phytase enzyme of *Aspergillus niger* fungus could be improved the bioavailability of phosphorus in rice bran.

MATERIALS AND METHODS

Thirty-two castrated pig crossbred Spoted Poland China and Chester White, 12 weeks old, initial BW were: block I - 32 ± 0.81 kg BW; block II - 36 ± 0.79 kg BW; block III - 40 ± 0.83 kg BW; block IV – 44 ± 0.78 kg BW were treatments randomly arranged in a 4 x 4 block design with 2 replication.

The treatments were differentiated in terms of fermentation duration of *Aspergillus niger* as follows R0 = not fermentation as control, R1 = 2 days fermented, R2 = 4 days fermented and R3 = 6 days fermented. Pigs were given one week to adapt to experimental diets.

Animals were fed twice daily at 8.00 pm and at 16.00 am with free access to fresh water throughout the trial.

Pigs were housed in individual pens (100 cm x 250 cm). Feed intake was measured daily and pigs were weighed weekly.

Animal were cared according to a recommended code of practice of animal welfare. They were fed the one ration common practiced by farmer (Table 1).

Table 1. Ingredient and chemical composition of diets

	(%)			
	T0	T1	T2	T4
Items				
Yellow corn	38.0	38.0	38.0	38.0
Rice bran*)	40.0	40.0	40.0	40.0
Fish meal	12.0	12.0	12.0	12.0
Coconut meal	7.5	7.5	7.5	7.5
Premix	2.5	2.5	2.5	2.5
*). Rice bran content in ration is same but difference according to the treatment (duration of fermentation)				
Chemical composition of rations (%)				
Crude protein	15.58	16.58	18.48	19.78
Crude fiber	11.51	11.20	10.13	8 .95
Ether Extract	11.77	10.38	9.32	8.40
NFE	53.34	52.47	52.12	52.81
Ash	7.80	9.37	9.95	11.06
Ca	0.95	0.96	1.14	1.17
P	0.59	0.65	0.76	0.80
GE (kg/g)	4113	4208	4289	4302

RESULTS AND DISCUSSIONS

The effects of treatments on all variables have been measured (Table 2). In our experiment all variable measured affected significantly higher by duration time of fermentation at treatment T3 or fermented up to six days compared to TO and T1. Except some variables from T2 treatment were not difference significantly compared to T3 treatment in term of energy intake, CP intake, Ca and P digestibility, and muscle cholesterol.

Data from this experiment showed the effective time for incubation was at day 4th to 6th which is agree to the earlier finding reported by (Kurniawan et al., 2016; Sands et al., 2009).

Phytate is a polyanionic molecule with the potential to chelate positively charged nutrients, which is almost certainly funda-mental to the anti nutritive properties of phytate.

But since almost of variables measured in our experiment increased significantly up to six days of fermentation time it is a proved that

phytate compromises the utilization of energy, protein and mineral (Selle and Ravidam, 2007). Moreover, it was recently reported that dietary phosphate deficiency has an immediately depressing effect on appetite, growth rate and feed efficiency of swine (Sefer et al., 2012).

Table 2. The effect of treatments on all variables measured

Variable	Treatments			
	TO	T1	T2	T3
Energy Intake (kcal/kg)	9563.00[b]	9783.00[b]	9971.00[a]	10654.00[a]
Crude Protein Intake (g/h/d)	336.00[b]	335.00[b]	401.00[a]	406.00[a]
Average Daily Gain (g/h/d)	663.00[c]	702.00[c]	723.00[b]	760.00[a]
Feed Efficiency	2.75[c]	2.63[c]	2.16[b]	1.89[a]
Ca Digestibility (%)	65.54[c]	70.86[b]	73.03[a]	72.56[a]
P Digestibility (%)	53.32[b]	55.19[b]	63.66[a]	64.26[a]
Bone Hardness (kN)				
• Metacarpal	0.87[c]	1.33[b]	1.50[b]	1.72[a]
• Metatarsal	1.05[d]	1.54[c]	1.65[b]	1.90[a]
• Femur	1.57[d]	2.00[c]	2.27[b]	2.50[a]
Back-fat Thickness (cm)	2.75[c]	2.63[c]	2.16[b]	1.89[a]
Blood Cholesterol (mg/dl)	152.50[c]	148.70[c]	138.20[b]	121.90[a]
Muscle Cholesterol (mg/100 g)	160.00[c]	149.00[b]	120.00[a]	116.00[a]

Different superscript in same row significant ($P<0.05$)

Average daily body weight gain is considered a reliable indicator of feed quality, especially in the investigation of phosphorus bioavailability in feedstuffs. Feed efficiency as an interaction between body weight gain and amount of feed consumed was significant higher at day 6th of incubation time or treatment T3 compared to other treatments.

This finding is agreed with previous research report (Woyengo et al., 2008). Bone Hardness is an reel indicator the availability and effectiveness work of phytase.

In our research showed that harness of bone of metacarpal, metatarsal and femur were significantly higher at treatment T3 compared the other treatments which is in agree with previous reported (Selle et al., 2009; Amerah et al., 2014).

From lipid parameter point of view in term of back-fat thickness, blood and muscle cholesterol at treatment T3 showed all significantly higher compared the other treatments.

Those phenomenon were probably close related with the yield of lipase enzyme produced by fermentation at day 4th of *Aspergillus niger* as high as 1.8 U/ml or equal to 420 U/g enzyme (Kurniawan et al., 2016).

This high amount of lipase was strongly stimulate by the presence of some Ca^{2+} and Mn^{2+} released from that fermentation (Adam and Ahmed, 2009).

CONCLUSIONS

Based on these results it could be concluded that utilization of 40% of rice bran fermented incubation along 6 days with *Aspergillus niger* able to improved feed efficiency and quality product of pig meat for human health.

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