Effect of different level of rice polishing in combination with phytase and acidifier on performance and shell quality of layer chickens

Bayu Sesarahardian, Osfar Sjofjan, and Eko Widodo

Department of Animal Nutrition, University of Brawijaya, Indonesia

ABSTRACT: The aim of the experiment was to examine the effect of increasing level of rice polishing when a combination of additive (phytase and acidifier) was added on layer performance and eggshell quality. A total of 120 Isa Brown Laying Hens of about 40 weeks old were allocated randomly into 3 main treatments (levels of rice polishing 10, 20 and 30 %) and sub-treatments of with and without addition of 0.09 % phytase and 0.4 % acidifier. Each treatment was repeated 4 times with 5 birds each. All birds were placed in open house system and housed in individual cages for 8 weeks. The birds offered water *ad libitum*, while feed was given approximately 117 g/bird/d. The experiment was arranged in a completely randomized design with nested type and significant differences among treatments were analysed by Duncan's Multiple Range Test. The results showed that layer performances were not significantly affected by additive addition nested to the rice polishing levels. Improvements were observed in favour of addition of phytase and acidifier to rice polishing containing diet. Improvements of eggshell quality might be explained by significantly better P deposition when 20 % of rice polishing was used. Nested effects of additive were in favour to the use of 30 % rice polishing. It is suggested to use 30 % rice polishing with additive (0.09 % phytase and 0.4 % acidifier) to the layer diet.

Keywords: rice polishing, phytase, acidifier, eggshell, layer

INTRODUCTION

Current trend indicates that strategy to reduce feed cost which is implemented by Indonesian chicken farmers is by making self-mixed diet. Self-mixed diet means that farmers formulate their own layer diets based on available feedstuffs. Fluctuation of availability of feedstuffs, especially yellow corn and rice polishing, not only alters the performances but also possibly reduces profit.

Recent advances in feed additives commercially available help to improve chicken performances. The most common feed additives used by commercial feed manufacturer are enzymes and acidifier. In the previous research, Dadang (2006) reported that the use of 35% rice polishing in layer diet did not significantly influence HDP. While Warren *et al.* (1990) only recommended 25% or Samli *et al.* (2006) suggested 5-15% with consideration of no HDP change. In an attempt to further improve performances of layer, increasing levels of rice polishing was combined with additive (namely 0.09% phytase and 0.4% commercial acidifier, suggestion from previous finding reported by Widodo *et al.* (2010). Since incidence of egg crack, egg misshape, egg shelless, etc. that make unexpected loss to the farmers is more than 3%, the use of additive may help to lift the profit.

MATERIALS AND METHODS

Birds Management

A total of 120 Isa Brown Laying Hens, approximately 40 weeks old were allocated randomly into 6 treatments with 4 replications and 5 birds for each replication. All birds were placed in open house system and housed in individual cages for 8 weeks. The birds offered water *ad libitum*, while feed was given approximately 117 g/bird/d. The average of temperature and humidity at 06.00 h were 24.39˚C and 91.73 % and at 13.00 h were 29.45˚C and 85.88 % respectively.

Treatments

The experiment was arranged based on main treatments (levels of rice polishing, namely 10 %, 20 % and 30 %) with sub-treatments of with and without addition of additive (0.09 % phytase and 0.4 % acidifier). The rice polishing used contained 86.37 % DM, 12.80 % CP, 7.68 extract ether, 10.72 % ash and 4071 kcal/kg gross energy. Ingredients used and the calculated nutrients composition were given in Table 1. Phytase was supplied as microbial phytase derived from *Aspergillus niger*. Acidifier commercial was used as a sources of carboxylic acids and ammonium salts.

Chemical Analysis

Dry matter, crude protein, extract ether, ash and energy contents of the diets and feedstuffs were determined by standard proximate analysis. Calcium content of eggshell were determined by titration method and phosphorus content of eggshell were determined by using spectrophotometer based on Sudarmaji *et al.* (1997).

Calculation and Statistical Analysis

Table 1. Ingredients and Nutrient Compositions of Experimental Diets

Ingredients	Treatment					
	T_1	T_2	T_3	T_4	T_5	T_6
Corn	54.39	54.39	44.46	44.46	34.53	34.53
Rice Polishing	10.00	10.00	20.00	20.00	30.00	30.00
Soybean meal	15.14	15.14	15.07	15.07	15.00	15.00
MBM	5.00	5.00	5.00	5.00	5.00	5.00
PMM	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	8.38	8.38	8.38	8.38	8.38	8.38
Palm Oil	3.00	3.00	3.00	3.00	3.00	3.00
DL-Methionine	0.20	0.20	0.20	0.20	0.20	0.20
L-Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Selplex[1]	0.03	0.03	0.03	0.03	0.03	0.03
Premix[2]	0.61	0.61	0.61	0.61	0.61	0.61
Phytase[3,4]	0	0.09	0	0.09	0	0.09
Acidifier	0	0.40	0	0.40	0	0.4
	Nutrient Compositions					
Metabolizable energy, Kcal/kg	2739.00	2739.00	2703.00	2703.00	2689.00	2689.00
Crude protein, %	18.00	18.00	18.00	18.00	18.00	18.00
Crude fiber, %	2.76	2.76	3.30	3.30	4.03	4.03
Ether extract, %	4.18	4.18	5.60	5.60	6.18	6.18
Ash, %	3.37	3.37	3.92	3.92	4.43	4.43
Lysine, %	1.12	1.12	1.13	1.13	1.16	1.16
Methionine, %	0.66	0.66	0.66	0.66	0.67	0.67
Tryptophan, %	0.19	0.19	0.20	0.20	0.20	0.20
Ca, (%	3.51	3.51	3.51	3.51	3.51	3.51
Total P, %	0.67	0.67	0.79	0.79	0.91	0.91
Available P, %	0.36	0.36	0.37	0.37	0.39	0.39

[1] Selplex contained 1000 ppm Selenium Yeast and other ingredients until 100 %, PT.Alltech International.
[2] Premix contained Ca 4,13 %; NPP 0,04 %; K 11,33 %; S 6,21 %; Cl 20,02 %; Fe 3906 mg; Mg 5781 mg; Co 390 mg; Cu 703 mg; Zn 3515 mg; Vit. A 2.000.000 IU; Vit. D 350.000 IU; Vit. E 3125 IU; Vit. K 390 mg; Vit B1 390 mg; Vit B2 781 mg; Vit. B6 468 mg; Vit B12 3,9 mg; Vit C 390 mg; Ca-D-panthotenate 1562 mg; Nicotinamide 4687 mg; Folic Acid 156 mg; Biotin 3,9 mg
[3] Phytase derived from *Aspergillus niger* that contain phytase activity 500.000 FTU/kg, PT. Trouw Nutrition Indonesia
[4] 0.09 % phytase equal with 450 FTU/kg feed

Data were calculated using Microsoft Excel and significant differences among treatments were analysed by Duncan's Multiple Range Test.

During the experiment, the number and weight of eggs were recorded daily, feed consumption and egg production were recorded weekly, egg mass and feed conversion were calculated weekly, IOFC was calculated in the last of experiment. Every 2 weeks, 1 eggshell from each replication were collected to measured eggshell thickness and in the last of experiment, the composite eggshell samples were then used to determine calcium and phosphorus contents of eggshell. Statistical analysis using a completely randomized design with addition of additive was nested within level of rice polishing.

RESULTS AND DISCUSSION

The results of this experiment were summarized in Table 2, 3, 4 and 5. In Table 2, the results indicated that no significant influence was reported for all variables tested. Therefore, HDP, egg mass and feed conversion ratio tended to decrease with increasing levels of rice polishing. While IOFC result suggested that the maximum profit would be obtained when 20% of rice polishing was used. Further evaluation on the effect of additive addition nested on levels of rice polishing showed that no significant influence was also reported. However, layer performances results indicated that addition of phytase and acidifier on rice polishing containing diet tended to improve HDP, egg mass and feed conversion. While IOFC result suggested that except for 10% rice polishing, the use of additive tended to increase IOFC, with maximum IOFC was obtained for level of rice polishing 20%. Current results were consistent particularly with the report of Dadang (2006), suggested that 30 % is tolerable level for layer since extended the level to 40 % rice polishing caused severe drop in layer performance (unpublished report). It might be interesting to further investigate the same experiment but at earlier age, before reaching peak, or just before culling the chicken. Under current experiment, increasing level of rice polishing was accompanied by decreasing level of yellow corn and the price of rice polishing, and yellow corn were 1450 IDR and 2500 IDR respectively. Therefore, larger margin price between yellow corn and rice polishing would cause an increase in IOFC with increasing rice polishing levels in the diet.

Table 2. Effect of Level of rice polishing on layer performances

	Treatment		
Variables	Rice polishing 10 %	Rice polishing 20 %	Rice polishing 30 %
HDP (%)	83.08 ± 6.48	81.07 ± 7.27	77.50 ± 5.99
Egg mass (g/bird/d)	50.21 ± 3.81	49.58 ± 4.95	46.91 ± 3.37
Feed conversion	2.37 ± 0.18	2.41 ± 0.26	2.57 ± 0.19
IOFC (IDR*)	1595 ± 667	1730 ± 938	1554 ± 572

1 US$ = 9120 IDR during the experimental period

Table 3. Effect of additive addition nested on levels of rice polishing on layer performances

Treatment	HDP, %	*Egg mass*, g/bird/d	Feed conversion	IOFC (IDR)
Rice polishing 10 %				
Without additive	82.23 ± 9.12	49.45 ± 5,01	2.41 ± 0,22	1666 ± 794
With additive	83.93 ± 4.91	50.96 ± 2,69	2.33 ± 0,16	1524 ± 629
Rice polishing 20 %				
Without additive	78.75 ± 8.90	47.99 ± 5,78	2.48 ± 0,31	1609 ± 1075
With additive	83.39 ± 5.46	51.16 ± 4,13	2.34 ± 0,23	1851 ± 925
Rice polishing 30 %				
Without additive	74.73 ± 5.81	45.31 ± 2,52	2.64 ± 0,16	1435 ± 513
With additive	80.27 ± 5.42	48.52 ± 3,63	2.50 ± 0,22	1673 ± 681

Effect of rice polishing levels on shell quality in Table 4 indicated that only P deposition in shell was significantly affected (P<0,05) by levels of rice polishing in layer diet. Regardless the significance levels, the use of 20% rice polishing tended to produce the best quality of egg shell. When the additive was then nested to levels of rice polishing, shell thickness and Ca and P deposition was significantly or highly significantly affected. The addition of additive showed more preferable results as compared to without addition of additive group. Tangendjaja *et al*. (2002) reported that 0.012 % phytase addition to a layer diet containing 22% rice polishing did not significantly affect egg weight of 23-48 week old layer. Ebrahimnezhad *et al.* (2007) combined the use of 300 FTU/kg phytase with 0.2 % or 0.4 % citric acid resulted no significant differences on the egg mass. In addition, current result suggested that phytase and acidifier used might be sinergically improved eggshell quality.

Table 4. Effect of rice polishing on shell quality

Variables	Treatment Rice polishing 10 %	 Rice polishing 20 %	 Rice polishing 30 %
Shell thickness, µm	385.36 ± 8.07	389.33 ± 12.09	385.50 ± 17.04
Ca Shell, %	39.97 ± 0.50	40.11 ± 0.29	39.98 ± 0.54
P Shell, %	0.19 ± 0.02^{b}	0.22 ± 0.04^{c}	0.18 ± 0.04^{a}

Superscript (a-c) at the same column indicated significant effect (P<0.05)

Table 5. Effect of additive nested on level of rice polishing on shell quality

Treatment	Shell thickness (µm)	Ca Shell (%)	P Shell (%)
Rice polishing 10 %			
Without additive	383.21 ± 9.09^{A}	40.07 ± 0.31^{A}	0.19 ± 0.03^{A}
With additive	387.50 ± 7.55^{A}	39.87 ± 0.68^{A}	0.19 ± 0.02^{A}
Rice polishing 20 %			
Without additive	381.67 ± 12.99^{A}	40.26 ± 0.15^{AB}	0.20 ± 0.04^{A}
With additive	397.00 ± 3.95^{AB}	39.97 ± 0.34^{A}	0.24 ± 0.03^{B}
Rice polishing 30 %			
Without additive	371.50 ± 11.58^{A}	39.52 ± 0.16^{A}	0.15 ± 0.02^{A}
With additive	399.50 ± 4.57^{B}	40.45 ± 0.26^{B}	0.22 ± 0.02^{AB}

Superscript (a-b) at the same column indicated different effect (P<0.05)
Superscript (A-B) at the same column indicated very different effect (P<0.01).

CONCLUSIONS

It might be concluded that the use of 30 % rice polishing with additive addition (0.09 % of phytase and 0.4 % acidifier) could be implemented for layer diet with significant expectation in eggshell improvement.

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