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Increasing Nutrition Value of Fermented Rice Hull through Biofermentation of Lactobacillus Complex Bacteria Supplemented

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Keywords

Bali duck;
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Nutrition value;
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Blood antioxidant profile;

Abstract

An experiment was carried out to determine the nutrition value and the effect of blood antioxidant profile of Bali duck of fermented rice hull through biofermentation and supplemented with betle leaf meal. A completely randomized design (CRD) with five treatments diets and four replications were used and each replicate consisted of five ducks. The treatment was diet A as control (diet without rice hull and betle leaf meal), diet B containing 10% rice hull, diet C containing 10% fermented rice hull, diet D containing10% rice hull and betle leaf meal, and diet E containing 10% fermented rice hull and betle leaf meal. The variables observed were: nutrition value of fermented rice hull, performance, and blood antioxidant profile. The results showed that fermented rice hull could improve the content of crude protein from 4.66% to 7.49%; energy extract 1.99% to 2.88%; nitrogen-free extract 8.66% to 19.01%; ash 16.41% to 23.53% and decrease the crude fiber 43.59 to 21.01%. Treatments A, B, C, D, and E were not significantly different on feed consumption (P>0.05). Provision of diet E can result in the highest of ration digestibility, antioxidant capacity, and final weight (P<0.05), and could increase of antioxidant capacity, superoxide dismutase (SOD) and decrease malondialdehyde (P<0.05) of Bali duck blood. It could be concluded that the fermented rice hull supplemented by Piper betle could improve the nutrition value of rice hull, performance, and blood antioxidant profile of Bali ducks.

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1. Introduction

The useful of rice hull for alternative feed needs to improve because the supply is fairly high. The grain milling into rice produced 17% of rice hull (Lubis, 1992). Rice hull contain high crude fiber, so it couldn't digest by monogastric such as duck with crude fiber content 43.3% and crude protein 3.8% (Bidura, 2007). To increase the nutrients value of diet, it needs biofermentation of EM-4 (Effective microorganisms-4) (Wididana and Higa, 1993). Yadnya *et al.* (2007) found that EM-4 solution biofermentation in sawdust changed crude fiber from 81,91% to 48,40%, crude protein from 0,90% to 8.10 %, ether extract from the 0.32 % to 2.30 %. Suwidjayana *et al*. (2005) reported that the provision of 10% and 20% of sawdust fermented with the EM-4 solution could increase ration digestibility and not affecting the performance of Bali ducks. Nuriyasa *et al.* (1998) found that provision of Effective Microorganisms-4 (EM-4) to *mannihot* tuber which contains pancreas extract could increase in vitro digestibility. Roni *et al.* (2006) reported that provision of a diet containing 5.97% rice hull and urea resulted slaughter weight lower than control treatment, but after supplemented by *starbio* resulted in no significant different (P>0.05) on slaughter weight and final weight.

Improving animal productivity needs diet component which content of antioxidant compound such as betle (*Piper betle* L.) leaf which contains flavonoid, *betlephenol, seskuitefen,* and *kavikol* (Adm, 2013), (Dewi, et al.: 2018). The antioxidant compound could neutralize free radical and also affect the metabolism processes in the body (Kumalaningsih, 2008). Sumardika and Jawi (2011) reported that offering of *Ipomoea batatas* L. leaf extract could improve lipid profile and increase the superoxide dismutase (SOD) value. Yadnya *et al.* (2015) reported that offering of diets containing fermented *Ipomoea batatas* L. skin could increase performance, feed antioxidant capacity and improve the antioxidant profile of Bali duck. Susila *et al.* (2016) reported that offering of fermented rice hull supplemented with *Ipomoea batatas* L. leaf meal could increase digestibility, performance, antioxidant capacity, and superoxide dismutase (SOD) but decrease *Malondialdehyde* (MDA) of Bali duck meat (Ogu, et al.: 2017), (Saxena: 2017).

The research was carried out to study the effort to increase the nutrition value of fermented rice hull supplemented with *Piper betle* L leaf meal and the effect of blood antioxidant profile of Bali duck.

2. Research Method

Material and Method

The research was conducted at Guwang Village, Gianyar Regency, Bali Province for 10 weeks. Nutrition value analysis of fermented rice hull consisted of crude protein, ether extract, crude fiber, nitrogen-free extract, ash and gross energy and carried out in the Laboratory of Nutrition, Faculty of Animal Husbandry, Udayana University for four weeks. Test of blood antioxidant profile was carried out at the Analytic Laboratory, Udayana University for two weeks.

Biofermentation with Lactobacillus complex Bacteria Solution of Rice Hull Supplemented with Betle Leaf Mea

Rice hull was mashed and mixed with Effective Microorganisms-4 (EM-4), urea, and molasses solution, then inserted into sacks and incubated for one week. After being fermented then dried and ready to use for the experiment.

Experimental Design

The experiment used a completely randomized design (CRD) with five treatments: the control diet (A), diet containing 10% rice hull (B), diet containing 10% fermented rice hull (C), diets containing 10% rice hull and 0.20% betle leaf meal (D), and diet containing 10% fermented rice hull and 0.20% betle leaf meal (E). Each treatment consists of four replicates and each replicate consist of five ducks with homogenous weight, so there were 100 male ducks with three weeks old. Diet consisted of yellow corn, soybean, copra meal, rice bran, fish meal, coconut oil, salt (NaCl) and B12 mineral. Rice hull with fermented or unfermented and meal leaf betle was allocated according to the treatments. The ingredient composition of treatments shown in Table 1 and the chemical composition is shown in Table 2.

This experiment used two floors battery colony cages system with 20 partitions. Each partition of the cages was 70 cm length, 65 cm width, and 70 cm height. Each partition was equipped with food trays and drinking water. Trays made from bamboo and located at the external part of the cages.

Table 1
Diet composition of Bali duck (age 3 – 10 weeks)

Ingredients (%)	Treatments				
	A	B	C	D	E
Yellow corn	55.36	49.98	49.98	49.98	49,.8
Soybean	9.37	12.45	12.45	12.45	12.45
Copra meal	11.31	9.82	9.82	9.82	9.82
Fish meal	10.13	8.10	8.10	8.10	8.10
Rice bran	13.26	7.00	7.00	6.80	6.80
Rice hull	-	10.00	10.00*	10.00	10.00*-
Betle leaf meal	-	-	-	0,20	0,20
Coconut oil	-	2.00	2.00	2.00	2.00
B12 Mineral	0.50	0.50	0.50	0.50	0.50
NaCl	0.15	0.15	0.15	0.15	0.15
Total	100	100	100	100	100

Notes:
A = control diet (without rice hull and betle leaf meal); B = diet containing 10.0% rice hull; C = diet containing 10% fermented rice hull; D = diet containing 10% rice hull and 0.20% betle leaf meal; E = diet containing 10% rice hull and 0.20% betle leaf meal

Table 2
The chemical composition of diet (age 3 – 10 weeks)

Chemical components	Unit	Treatments					Standard: Scott *et al.,* (1982).
		A	B	C	D	E	
Metabolizable energy	kcal/kg	2879.17	2826.25	2823.37	2812.49	2826.59	2800-2900
Crude protein	(%)	17.12	16.32	16.36	16.31	16.38	15 - 17
Ether extract	(%)	5.75	6.11	6.23	5.92	5.94	3 - 6

Crude fiber	(%)	4,56	7,69	5,40	7,55	5,15	6 - 9
Calcium (Ca)	(%)	1.0	0.95	0.96	0.95	0.96	0.80
Available phosphorus (P)	(%)	0.80	0.65	0.52	0.58	0.60	0.45

Notes:

A = control diet (without rice hull and betle leaf meal); B = diet containing 10.0% rice hull; C = diet containing 10% fermented rice hull; D = diet containing 10% rice hull and 0.20% betle leaf meal; E = diet containing 10% rice hull and 0.20% betle leaf meal

Variables Observed

Variable observed were nutrition value (crude protein, ether extract, crude fiber, nitrogen-free extract, ash, and gross energy), feed consumption, feed antioxidant capacity, ration consumption, ration digestibility, final body weight, body weight gain, feed conversion ratio, and blood antioxidant profile.

Data Analysis

Data were analyzed with analysis of variance if there were significant differences among the treatment analyzed continued using Duncan's Multiple Range Test ($P<0.05$) (Steel and Torrie, 1989).

3. Results and Analysis

The nutrition value of rice hull through biofermentation of Lactobacillus complex bacteria and supplemented with betle leaf meal is shown in Table 3.

Table 3
The nutrition value of fermented rice hull through biofermentation of lactobacillus complex bacteria supplemented with betle leaf meal

Variable	Before fermentation	After fermentation
Crude protein (%)	4.66	7.49
Ether extract (%)	1.99	2.88
Crude fiber (%)	43.59	21,01
Nitrogen free extract (%)	8.66	19.01
Ash	16.41	23.53
Gross energy (kcal/g)	2.7636	3.1493

In biofermentation process, urea change by urease enzyme to be CO_2 and NH_3 as a source of amino acid groups, and the EM-4 solution could produce cellulase, protease, and lipase enzyme (Wididana and Higa, 1993). Polichacarida in rice hull is changed to be oligosaccharide by cellulase enzyme, then to be disaccharide by maltase enzyme, and finally to be simple sugar compound. It causes the increasing of nitrogen-free extract from 8.66% to 19.01% and crude fiber decrease from 43.59% to 21.01%. The existence of NH3 in urea hydrolysis will react through transamination and form a new amino acid (biochemical process) (Murray *et al.*, 2009) with the following reaction:

HH
R –C- COOH + NH3 R-C.-COOH + H2O (Murray *et al.*, 2009).
OH Gas Ammoniak NH2
Hydroxy carboxylase acid Amino acid

The existence of transamination causes the increasing of the crude protein content of rice hull from 4.66% to 7.49%. and gross energy content from 2.7636 kcal/g to 3.1493 kcal/g. The results of this study are appropriate with Yadnya et al. (2007) experiment which found that biofermentation in sawdust could increase crude protein and decrease crude fiber.

Biofermentation of Rice Hull Supplemented with Betle Leaf Meal on Performance of Bali Duck

The offering diets containing fermented rice hull through biofermentation of Lactobacillus complex bacteria supplemented with betle leaf meal on performance of Bali duck showed in Table 4.

Table 4
Biofermentation of lactobacillus complex bacteria supplemented with betle leaf meal on performance of Bali duck

Variables	Treatment[1)]					SEM[3)]
	A	B	C	D	E	
Feed consumption (kg/head)	4.354	4.434	4.397	4.400	4.398	139.16
Feed antioxidant capacity (IC%)	3.97c[2)]	3.26c	4.96b	5.10a	5.25a	1.016
Ration digestibility (%)	72.55bc	70.31c	76.38a	75.88ab	76.68a	0.093
Final body weight (kg/head)	1.251c	1.184d	1.328a	1.287b	1.375a	11.191
Body weight gain (g/head)	962.50d	898.50e	1039.20b	999.20c	1090.20a	8.21
Feed conversion ratio (FCR)	4.51b	4.93a	4.40c	4.22d	4.07e	0.01

Notes :

1) A = control diet (without rice hull and betle leaf meal); B = diet containing 10.0% rice hull; C = diet containing 10% fermented rice hull; D = diet containing 10% rice hull and 0.20% betle leaf meal; E = diet containing 10% rice hull and 0.20% betle leaf meal
2) Values with different letters in the same row means significantly different (P<0.05)
3) SEM: Standard Error of The Treatment Means

Feed consumption on treatment A was not significantly different (P >0.05) compared with treatment B C, D, dan E because the nutrient content provided for all treatments were in accordance with the standard rations of Scott *et al*. (1982). Wahju (1992) stated that the primary nutritional need for ducks is energy followed by other nutrient content.

Feed antioxidant capacity in the control diet (treatment A) is 3.97 IC% (Table 4). Offering treatment B could decrease feed antioxidant capacity 17.63% lower than diet A, but not significantly different (P>0.05). Provision of treatment C, D, and E could increase significantly (P<0.05) the feed antioxidant capacity than treatment A, respectively 24.93%; 28.46% and 32.24%. The antioxidant compound could increase antioxidant capacity. Susila *et al.* (2016) reported that diet containing fermented *Aspergillus niger* and supplemented with *Ipomoea batatas* leaf meal could increase feed antioxidant capacity. Betle leaf containing *betlephenol*, *sesquiterpene,* and *karvokiol* (Agung, 2009) affected to feed antioxidant capacity. Provision control diet (treatment A) resulted ration digestibility is 72.55% (Table 4), treatment B decreased ration digestibility, but not significantly different (P>0.05) compared with treatment A. Provision of C, D, and E treatment could increase ration digestibility significant different (P <0.05) than treatment A, respectively 5.27%, 4.58%, and 5.69%. Biofermentation of rice hull supplemented with betle leaf meal could increase the nutrition value, final body weight and give positive effect to the antioxidant capacity of Bali duck. The existence of enzymes in EM-4 solution and supplemented with betle leaf meal could increase feed antioxidant capacity, ration digestibility, and effect to the weight gain, final weight gain, and improve feed conversion ratio (FCR). The results of this study are consistent with those obtained by Susila *et al.* (2016). Yadnya *et al.* (2012) reported that biofermentation of *Ipomoea batatas* L. skin by *Aspergillus niger* could improve antioxidant capacity and final body weight, ration digestibility causes effect the body weight gain (Yadnya *et al.,* 2012).

Rice hull biofermentation of Lactobacillus complex bacteria supplemented with betle leaf meal on blood antioxidant profile of Bali duck

Table 5
Rice hull biofermentation of lactobacillus complex bacteria supplemented with betle leaf meal on blood antioxidant profile of Bali duck

Variables	Treatment[1]					SEM[3]
	A	B	C	D	E	
Antioxidant capacity (IC %)	34.9c[2]	41.14b	49.28a	50.30a	51.89a	0.8494
Superoxide dismutase(µ/ml)	0.660e	0.7675d	0.830c	0.8875b	0.945a	0.0142
Malondialdehide (mmol/g)	3.445a	3.1125bc	3.1625b	2.827c	2.155d	0.0486

Notes :

1) A = control diet (without rice hull and betle leaf meal); B = diet containing 10.0% rice hull; C = diet containing 10% fermented rice hull; D = diet containing 10% rice hull and 0.20% betle leaf meal; E = diet containing 10% rice hull and 0.20% betle leaf meal
2) Values with different letters in the same row means significantly different (P<0.05)
3) SEM: Standard Error of The Treatment Means

Bali duck fed with diet control (treatment A) produced 34.90 IC% antioxidant capacity (Table 5). Provision of treatment B, C, D, and E could increase significantly (P<0.05) the blood antioxidant capacity compared to treatment A. Diet containing high antioxidant capacity could neutralize the free radical (Kumalaningsih, 2008), so treatment B, C, D, and E could increase the value of blood antioxidant capacity. Susila *et al*. (2016) reported that offered of rice hull fermented with *Aspergillus niger* and supplemented with *Ipomoea batatas* L. could increase meat antioxidant capacity which is caused by increasing of feed antioxidant capacity content. Provision of treatment A resulted in superoxide dismutase (SOD) 0.66 µ/ml (Table 5). Bali duck fed treatment B, C, D, and E could increase SOD significant (P<0.05) higher compared with treatment A. Susila *et al.* (2016) reported that offering diets containing rice hull fermented by *Aspergillus niger* and supplemented with *Ipomoea batatas* L. leaf meal could increase level of meat SOD of Bali duck. Sumardika and Jawi (2011) reported that offering *Ipomoea batatas* L. leaf extract in diet could increase level SOD of rat blood serum. Blood *Malondialdehyde* (MDA) on treatment A is 3.445 mmol/g (Table 5). Offering diets on treatment B, C, D, and E could decrease blood MDA significantly (P<0.05) compared with treatment A. Decreasing of MDA level in the blood has a correlation to improve antioxidant capacity (Yadnya *et al.,* 2015). This is in accordance with the result of Susila *et al*. (2016) experiment which offered fermented rice hull supplemented with *Ipomoea batatas* L. leaf could increase the antioxidant capacity and superoxide dismutase, but decrease malondialdehyde significantly (P<0.05).

4. Conclusion

From the results of this study, it could be concluded that fermented rice hull through biofermentation of lactobacillus complex bacteria supplemented with *Piper betle* leaf meal could improve the nutrition value, performance, and blood antioxidant profile of Bali duck.

Conflict of interest statement and funding sources
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Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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