Nutritional Value of Rice Bran Fermented by *Aspergillus niger* and Its Effect on Nutrients Digestibility of Broiler Chickens

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***Abstract*—This study was conducted to determine the effect of rice bran fermentation product in diet to the nutrients digestibility of broiler chickens. Eighteen adult broiler chickens CP 707 35 days of age were conducted in metabolic cage, each treatment placed 4 chickens. The design of the research used was a complete randomized design with 4 treatments and 5 replications. The treatments were applied as follows: R0 = ration with non-fermented rice bran content, R2 = ration with 20% fermented rice bran, R3 = ration with 30% fermented rice bran and R4 = ration with 40 % fermented rice bran. The experiment was done with standard total excretion collection method. The excreta collection is weighed daily and dried in an oven at 55 ° C. Ration and excreta were chemically analyzed. The parameters were protein, crude fibre, Ca and P digestibility. The results showed that the rice bran fermented with *Aspergillus niger* increased the protein content (9.70 - 13.07%) and crude fiber (20.79), calcium (0.22 - 0.31) phosphorus (0.22 -0.31). The addition of fermented rice bran rice real (P>0.05) fiber protein digestibility. crude fiber, calcium, and phosphorus. Treatment of 20% rice bran fermentation product in the best rations.**

***Index Terms*—rice bran, fermentation, broilers, digestibility, nutritional value**

I. Introduction

Rice bran is a major cereal by-product available for animal feeding in rice-growing countries. It contains a good content of protein (13.20 to 17.13%), fat (14.00 to 22.90%), carbohydrate (16.10%), fiber (9.50 to 13.20%), and vitamins and minerals [1], [2]. Rice bran is a feedstuff that is often used in the preparation of broiler rations. The limited use of fine bran as a mixture of poultry feed is low of protein content, easily rancid, and the presence of phytic acid that bind Ca and P minerals, and bind proteins into protein-complex phytates that have a decrease in benefits and digestibility [3]. According to Cheeke [4] in addition to containing high phytate, fine bran also contains high silica. The presence of antinutritional factors in bran and its poor digestibility further aggravate the feeding problem, leading to mortality and poor performance of broilers [5].

Other antinutritional compounds found in rice bran that need processing to inactivate include trypsin inhibitors [6] and an antithiamine factor [7]. The use of rice bran in large amounts or exceed 30% in ration without improving the nutritional value will give negative implications on livestock. The previous researchers had attempted to use different techniques, such as fermentation [8], enzymes supplementation [9] and inclusion of the fermented product [10] in increasing rice bran utilization for poultry feed. Biotechnology fermentation using microbes can increase the nutrient value and quality of the ingredients. Winarno and Fardiaz [11] suggested that fermented foods have higher nutritional value than their original ingredients.

Utilization of microbes can improve the quality of feed ingredients. Wolayan, *et al*. [12] have used *Aspergillus niger* on coconut waste mix and tofu waste to increase protein and decrease crude fiber and increase protein digestion of fermentation products. Najoan, *et al.* [13] found that the use of *Trichoderma viride* microstructure increased the nutritional value of fermented products, as did Bidura [14] who examined the use of fermented rice bran by *Saccharomyses cerevisiae* in duck rations to find that duck performance improved. Kang, *et al* [15] reported that dry matter was significantly higher in the unfermented rice bran than in the fermented rice bran by *Lactobacillus plantarum, Saccharomyces cerevisiae* and *Bacillus subtilis.* Yet, the crude protein content of the fermented rice bran was higher than that of the unfermented rice bran. Both crude ash and crude fibre content differ between fermented and unfermented rice bran

The rice bran fermentation product allowed to increase levels of use in the ration. But what percentage of its use needs to be investigated. This research provides information about the improvement of digestibility and nutrient value of rice bran fermentation products with *Aspergilus niger* through fermentation process.

II. Materials and Methods

This study used fermentor materials and substrates such as fine bran, *Aspergillus niger* chemicals grown like, pure *Aspergillus niger*. The process of fermentation, that is molded, sterilized and then input in plastic bag, added inoculant 10 gr/kg of rice bran, stored at room

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temperature 25^o C – 30^o C for 6 days after that dried and analyzed the chemical compound.

In this experiment, 80 broiler chickens Strain CP 707 35 days of age were utilized for determination of crude protein, crude fibre, calcium and phosphorus digestibility, through the standard total excretion collection method. Based diet was commercial complete based diet and dietary treatments were basal diet (R0) = 20% unfermented rice bran; (R1) = 80% basal diet + 20% rice bran fermentation product; (R2= 70% basal diet + 30% rice bran fermentation product, (R3) and 60% basal diet + 40% rice bran fermentation product. The nutrients composition of feedstuffs and the diets were shown in Table I and Table II.

TABLE I. THE NUTRIENTS COMPOSITION OF FEEDSTUFFS

Feedstuffs	Nutrients					
	Crude Protein (%)	Crude Fiber (%)	Fat (%)	Ca (%)	P (%)	GE (Kcal/kg)
Yellow Corn	9.81	2.78	4.9	0.01	0.33	4052
Soybean Cake	47.04	8.72	1.8	0.18	0.55	3903
Fish Meal	55.00	2.12	11.91	3.10	2.60	3801
Unfermented Rice Bran	9.70	29.25	7.67	0.22	0.95	3245
Fermented Rice Bran	13.07	20.79	5.96	0.31	1.42	3627

TABLE II. DIETS AND NUTRIENT CONTENT

Feedstuffs	Dietary Treatments			
	R0	R1	R2	R3
Unfermented Rice Bran	20	-	-	-
Fermented Rice Bran	-	20	30	40
Yellow Corn	55	55	45	35
Soybean Cake	10	10	10	10
Fish Meal	14	14	14	14
Premix	1	1	1	1
Total	100	100	100	100
Nutrients Content:				
Crude Protein (%)	19.74	20.41	20.74	21.07
Crude Fiber (%)	8.55	6.86	8.66	10.46
Crude Fat (%)	6.08	5.73	5.84	5.95
Ca (%)	0.50	0.52	0.55	0.58
P (%)	0.79	0.89	0.99	1.1
GE (Kcal/kg)	3800.24	3876.64	3833.94	3791.44

Notes: GE = gross energy

The experimental diets were formulated is-oprotein and is-ocalory, contained 22% CP and 2900 Kcal ME/kg. The experimental period was of 7 days: three for birds to adapt to cages, diets and management, one for fasting and three for total excreta collection. The experimental design was completely randomized, with four treatments and five replicates of one bird. Chicks were raised in metabolic cages fitted with mechanism for quantitative feeding and faecal collection. The excreta of all experimental units were collected daily on trays covered with plastic. The collected excreta were sprayed by 5% boric acid solution to prevent any loss in ammonia, then dried in an oven at 55 0C for 24 hours, then after weighed, finely ground and kept for chemical analysis according to AOAC [16] methods. The digestibility values for crude protein (CP) and crude fibre (CF), Calcium and phosphorus were calculated as nutrient intake minus nutrient excreted divided by nutrient intake multiplied by hundred [17], with equations as follow:

$$AND = \frac{FI \times \%\,NI - Fecal \times \%\,NF}{FI \times \%\,NI} \times 100$$

AND = apparent nutrient digestibility
FI = feed intake
NI = nutrient intake
NF = nutrient fecal

III. RESULTS AND DISCUSSION

A. *Nutritional Value*

Results showed that the nutritional value of rice bran fermentation product, were increasing in crude protein (9.70%-13.7%), and decreassing in crude fiber (29.25 - 19,79), calcium content (0.22 -0.41%), and phosphorus content (0.95 – 2.02%).

This result was in line with Supriyati, *et al*. [18], that the nutrient content of rice bran improved after fermentation and the utilization of fermented rice bran as a feed ingredient for broiler chickens could be included up to 15% of the broiler diet. The effects of dietary rice bran on crude protein, crude fiber, calcium and phosphorus digestibility of Broilers were shown in Table III.

B. *Crude Protein Digestibility*

The value of crude protein digestibility was significantly different from the control ration (R0) without the rice bran fermentation. The results obtained in this study are ranged 68.25 -79.05 %. Wahju [19] suggested that poultry protein digestibility ranges from 70 to 85%. The addition of fermented rice bran in the diet can improve the digestibility of crude protein. Widodo, *et al*. [20] stated that the high digestibility depends on the ingredients of the ration and the amount of protein in the digestive tract. Increasing digestibility of crude protein by addition of fermented rice bran at treatment of R1, R2, and R3, possibly caused by activity of microorganisms that can improve the quality of feed ingredients that have an impact on increasing protein digestibility.

Increasing the protein digestibility value due to fermentation is a reflection of the decomposition of rough protein components easily digested. The increasing protein digestibility will facilitate the metabolism of proteins so that it will directly increase the weight gain [21]. The low protein digestibility in the treatment of R0, the ration without the fermentation product caused by the phytate in the rice bran. Akyure, *et al*. [22] reported that phytate may form a complex with proteases such as trypsin and pepsin in the gastrointestinal tract so that it can reduce the activity of the digestive enzymes which result in decreased protein digestibility.

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TABLE III. EFFECTS OF DIETARY RICE BRAN ON CRUDE PROTEIN, CRUDE FIBER, CALCIUM AND PHOSPHORUS DIGESTIBILITY OF BROILERS

Parameters	Dietary Treatments				p-value
	R0	R1	R2	R3	
ACP Digestibility (%)	68.25 ± 5.73^{a}	79.05 ± 1.884^{b}	75.13 ± 1.739^{c}	72.24 ± 1.999^{c}	.001
ACF Digestibility (%)	48.80 ± 2.89^{a}	56.74 ± 2.41^{b}	53.18 ± 3.56^{c}	51.47 ± 3.12^{c}	.001
ACa Digestibility (%)	45.26 ± 4.12^{a}	59.46 ± 3.32^{b}	50.11 ± 3.29^{c}	51.47 ± 2.62^{c}	.000
AP Digestibility (%)	31.26 ± 5.46^{a}	40.40 ± 2.55$^{a\,b}$	38.16 ± 4.04^{c}	32.19 ± 4.88^{d}	.22

Notes: ACP = Apparent Crude Protein; ACF = Apparent Crude Fiber; ACa = Apparent Calcium; AP = Apparent Phosphorus

C. *Crude Fiber Digestibility*

The treatment showed a significantly on the digestibility of crude fiber in broilers. The treatment using a finely ground fermented rice bran ration resulted in higher crude fiber digestibility values compared with the rice bran treatment without fermentation. This is because the fermentation process can reduce the levels of crude fiber rations so that will affect the digestibility of crude fiber. Maynard, *et al*. [23] reported that the digestibility of crude fiber is influenced by several factors including fiber content in the feed, crude fiber composition and microorganism activity.

According to Wina [24], fermentation is one of the technologies to improve the quality of feed of waste, because of the involvement of microorganisms in degrading crude fiber, reducing lignin levels and anti-nutrient compounds, so that the value of food digestibility from waste can increase. Average crude fiber digestibility values in this study ranged from 48.80 to 51.47%. The high content of crude fiber in the diet will affect the digestibility value, and the high crude fiber content in the ration will decrease the digestibility value, which in turn will affect digestibility.

Crude fiber cannot be digested by the poultry's digestive system, because poultry does not have microorganisms that can produce selolitic enzymes in the digestive tract [19]. Treatments of rice bran by different levels of antioxidant had no effect on digestibility of fat and fiber when incorporated in broiler feed. Fiber digestibility of experimental feeds ranged between 10.96 to 11.44% in different trials with average value of 11.24% [5].

D. *Calcium Digestibility*

The results showed that the treatment had a significantly effect on calcium digestibility. The treatment of R0 was significantly lower than that of R1, R2 and R3. The low calcium digestibility in R0 treatment using rice bran without fermentation was due to minerals including calcium and phosphorus bound to phytic acid [25], that most minerals including calcium and phosphorus from plant sources include grains bound in phytic acid and cannot be digested. Treatment using rice bran product fermentation was higher than the rice bran fermentation product in the ration. Lei, *et al.* [26], states that in the presence of the phytase enzyme produced by *Aspergillus niger* molds, affect to the availability of calcium previously bound to phytic acid. According to Mandey, *et al*. [27], cellulose in fiber produced the bulkiest fecal material and had the fastest transit rate, that may indicate that cellulose affects absorption of minerals mainly through increased bulkiness and decreased transit time, and will decrease the frequency of mucosal-mineral interactions necessary for absorption. Harmuth-Hoene and Schelenz [28] reported that the inclusion of various fibers into the rat diets produced lower apparent availability of copper, iron, zinc, magnesium, calcium and phosphorus.

E. *Phosphorus Digestibility*

The results showed that the treatment gave a significant to the phosphorus digestibility. Phosphorus digestibility in treatment R0, ration that does not contain rice bran fermentation product, was significantly lower than in treatments R1, R2 and. Increasing of phosphorus digestibility due to fermentation process with *Aspergillus niger* can produce phytase enzyme. Lei [29] reported that microbial phytase was able to improve the availability of phosphorus from phytic molecules. However, the increased rice bran level of the fermentation product further decreased the phosphorus digestibility. In contrast, Iyayi, *et al* [30] reported that phytase supplementation expressed in *Aspergillus oryzae* increased P retention from 10 to 61% in black-eyed pea and from 74 to 84% in peanut flour, an indication of better P utilization by phytase in both feed ingredients. True P digestibility in black-eyed pea and peanut flour were 29 and 67%, respectively, without phytase, and supplementation with phytase.

IV. CONCLUSION

From the results of this study, it can be concluded that rice bran fermentation product can be fed to broiler chickens at up to 40% in the rations broilers.

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