Implementation of fermented rice bran as a flavor enhancer additive and its effect on feed utilization and beef cattle performance

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ABSTRACT: The objective of this experiment was to study the effect of fermented rice bran implementation as a flavor enhancer additive on feed utilization and cattle performance. The study was conducted in the Livestock Group at Sukoliman Village, Gunungkidul, Yogyakarta from February until March 2010 (for 4 weeks). The experiment used 25 heads of cattle with two different kinds of treatments; there were control diet containing unfermented rice bran and treatment diet containing fermented rice bran (± 40 g/day). Fermented rice bran as a flavor enhancer additive consisted of rice bran, chitin chitosan waste as mineral sources and inoculums (*Rhizopus* sp.) and contained crude protein, minerals, and amino acids. Data collected included feed consumption (daily), feed conversion ratio (cumulative), body weight (weekly), and average daily gain (daily). The data were analyzed using t-test of statistical analysis. The results showed that fermented rice bran as a flavor enhancer additive on diet for 4 weeks of observation could produced more efficiency ($P<0.05$) in feed conversion ratio (28.24) than control diet (30.53) and increased the body weight gain ($P<0.01$: 11.93 vs. 1.57 kg/head/4 weeks). The fermented rice bran as a flavor enhancer additive on diet could increased the average daily gain ($P<0.01$: 0.43 vs. 0.06 kg/day). It can be concluded that the fermented rice bran by *Rhizopus* sp. has caused changes in texture and flavor of feed ingredients that made fermentation products more attractive, easily digestible, and nutritious so that it has significantly improved the cattle performance.

Key words: rice bran, Rhizopus sp., flavor enhancer, feed, performance, cattle

INTRODUCTION

Feed is the most important factor to support the livestock farming. Livestock production depends on the provision of good quality feed. In addition, in the livestock business, the cost of feed could reach the highest percentage of production cost for almost 50-70%. Good feed not only had a complete nutrient content but should also be preferred by livestock. Many efforts were undertaken to improve the quality of feed through feed additive supplementation in diet the feed material in order to increase the nutrient elements and the quality of digestibility in the body.

Feed additive is a material created or prepared for later amalgamated to form a complete feed or feed supplement (supplementary) which should not be given as a supplement or given freely without mixed. U.S patent no: U.S. 6.322.827 BI said that through the method of simultaneously protecting protein supplement could protected the protein content in ruminant feed so that 50-70% of proteins could passed through the digestive process of rumen digestion to be absorbed by the intestine. This U.S patent only made feed additive with carbohydrates and protein protection mechanisms using certain chemicals that were not degraded in the rumen. Whey protein was used as a feed additive to increase protein content in animal feed (U.S patent no. 5.643.622). Patent on feed additive derived from organic materials which aimed to improve the taste had not been widely produced. In U.S patent no. 6.805.897 B2 mentioned a feed additive production process using high temperature and pressure. U.S patent no: 4.089.979 made the formulation of feed additive in gel or liquid form.

Feed technical problems are often faced in livestock farming. One of that was the low level of feed intake by cattle so the feeds much wasted. This condition occurs because of an aversion of cattle to consume feed due to feed characteristic that is less favored by the cattle. The use of feed additives are generally intended to improve digestibility of feed ingredients, increase the nutritional quality and improve the performance of the digestive system in cattle through the balancing mechanism of

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microflora in the cattle rumen. This function sometimes can not be met by feed additive products. Feed additive as a flavor enhancer has not been found a lot in the market so there is still widely open.

Feed additive products for enhancing the performance of ruminant digestion were more produced in liquid form and thus require special handling at the time of appropriation in cattle. Sometimes this caused reluctance of farmer to use the product in liquid form. When it was added in diet, the feed will easily rotten if it was not consumed by cattle. The liquid product is heavier so that the distribution becomes more difficult. Feed additive product in powder form has a chance to be developed considering the characteristic which more durable and easier in terms of its use.

MATERIALS AND METHODS

Materials

The material in this experiment contained rice bran from white rice *Oryza sativa*, inoculums (*Rhizopus sp.*), and chitin chitosan waste. A number of 25 heads of cattle in average 1.5 – 2 years from various breeds (Simmental, Limousine, Brangus, and Java) with various conditions (bull, breeder, and calf) were obtained in this experiment.

Experiment Procedure

Preparation of fermented rice bran was carried out by five steps; 1) making inoculums (*Rhizopus sp*.), 2) mixing process, 3) incubation, and 4) drying process. Each step performed with the following procedure:

1) *Rhizopus sp.* was made by isolating the tempeh and then cultured it in PDA medium (potato dextrose agar) and incubated for 3-5 days. The isolates obtained then cultured in the PDB medium (potato dextrose broth) for 5-7 days. PDB medium was made by boiled 500 g potatoes in 2.5 liter distilled water then filtered the potato infusion and added 50 g dextrose. This PDB medium was sterilized with temperature of 121ºC for 15 minutes at 2 atmosphere pressure.
2) Mixing process used a horizontal mixer with capacity of 50 kg/batch. Making process carried out by mixing rice bran (50 kg) with deproteinization chitin chitosan waste (2.5 liter) and distilled water/boiling water (17.5 liters). After 5-10 minutes (when the mixture temperature 30-40ºC), inoculums (2.5 liter) was added to the mixture.
3) Incubation was carried out in room conditions with temperature of 27ºC and humidity of 75% for 7 days.
4) After incubation for 7 days, fermented rice bran was dried under the sun heat (2 days), followed by dried it in oven (temperature 70ºC for 2 hours) until the moisture content was less than 10% then the fermented rice bran was grinded to obtain a desired mesh (60).

The experiment lasted for four weeks with two different kinds of treatments: there were control diet containing unfermented rice bran and treatment diet containing fermented rice bran (± 40 g/day). The `cattle fed native grass forage such as Kolonjono (*Panicum muticum*), grass field, vegetables and herbs as much as ± 15 kg per day, while the provision of agricultural waste which, rice straw was usually given during the dry season. Concentrate feed such as rice bran was given 1-2 times per day as much as 3% body weight. Fermented rice bran as a flavor enhancer additive was given as much as ± 40 g/d. Provision of drinking water was ad libitum with the addition of salt for some cattle.

Variables observed in this experiment were:

1) Feed consumption (kg), calculated every day based on the difference between feed offered and refused.
2) Feed conversion ratio (cumulative), obtained by dividing the amount of feed consumed by cattle (kg) with the product produced by cattle (kg).
3) Body weight/BW (kg), calculated every week by measuring chest circumference (cm) according to Schoorl's equation as follows:

$$BW = \frac{(\text{Chest circ.} + 22)^2}{100}$$

4) Average daily gain (kg), obtained by dividing the weekly body weight (kg) data with the number of days in a week.

Data Analysis

The data were analyzed using t-test of statistical analysis to study the effect of fermented rice bran as a flavor enhancer to the cattle performance.

RESULTS AND DISCUSSION

Nutrient Content

Rice bran is one of the most abundant and locally available agricultural wastes which contain variable ingredients such as carbohydrate that maybe used as a carbon and energy source for the growth of fungi in the production of single cell protein (Khan *et al*., 1992). Fermented rice bran by *Rhizopus sp.* and unfermented rice bran contained of nutrients as follows (performed in Table 1):

Table 1. Nutrient Composition of Treatments

	Treatments		Enhancement	
Composition,%	Unfermented Rice Bran	Fermented Rice Bran	Value	%
Dry Matter	83.54 ± 0.02^{A}	88.78 ± 0.25^{B}	5.24	6.27
Ash	12.51 ± 0.04^{A}	8.09 ± 0.02^{B}	(4.41)	(35.28)
Crude Protein	15.04 ± 0.02^{a}	15.37 ± 0.07^{b}	0.33	2.19
Fat	2.07 ± 0.00^{A}	17.62 ± 0.12^{B}	15.55	750.87
Crude Fiber	17.78 ± 0.22^{A}	9.09 ± 0.21^{B}	(8.70)	(48.90)
Calcium	0.12 ± 0.00^{A}	0.14 ± 0.00^{B}	0.02	18.99
Phosphor	0.07 ± 0.00^{a}	0.08 ± 0.00^{b}	0.01	17.87

* Dry matter basis (%)

Table 1 showed that in generally, through fermentation, the nutritional value of rice bran increased because the fungus role as a microorganism which could produced single cell protein and also can release enzymes that can break down the food substances to be easily digested (Rarumangkay, 2002). Fermented rice bran had higher ($P<0.01$) dry matter basis (88.78%) than unfermented rice bran (83.54%). This occurs because the increased of microbes biomass that grow in the fermentation process. Febrisiantosa *et al.* (2008) had reported that the addition of chitin chitosan waste increased dry matter basis on fermented rice bran by *Aspergillus niger* (91-93%).

Fermented rice bran contained 2.19% ($P<0.05$) crude protein (15.37%) than unfermented rice bran (15.04%). This result was lower than the experiment by Hong *et al.* (2004) whom reported that fermented soybean meals by *Aspergillus oryzae* contained 10% more crude protein than raw soybean meals. In the previous study, Akindahunsi *et al*., (1999) reported that *Rhi zopus oryzae* fermentation of cassava increased the protein content of both the flour (8.66%) and gari (5.60%) compared to the unfermented cassava products (flour, 4.43%; gari, 3.64%). The enhancement of protein contents may be due to the fact that *Rhizopus orvzae* which degrades cassava products readily may have secreted extra cellular enzymes in the cassava pulp, which consequently increased the protein content of the flour and the gari, as well as the microbial biomass. Tabrany *et al.* (2003) also reported that cassava fermentation using *A. niger* molds with addition of 4% urea and ammonium sulfate as a nitrogen source, increased the crude protein content from 2.2% to 18% dry matter. During the fermentation process there was a change of protein and amino acid nitrogen so that the dissolved nitrogen and protein contents increased by the proteolytic activity of *Rhizopus sp.* (Akindahunsi *et al.*, 1999; Vig

and Walia, 2001). Moreover, some fractions of simple carbohydrate that easily degradable were used by microbes for growth. This implicates to increase the relative percentage of protein content in the fermented rice bran.

Fat content in the fermented rice bran also increased (P<0.01) as much as 17.62% than unfermented rice bran (2.07%) due to high lipolytic activity in fungus *Rhizopus sp*. and produces a powerful antioxidant. Oboh and Akindahunsi (2003) reported that *Saccharomyces cerevisae* which used in the fermentation of cassava pulp were significantly increased the fat contents [flour (4.5%), gari (3.0%)]. Furthermore, the fungus *Rhizopus sp*. could produced the enzyme amylase after 48 hours of fermentation, but the activity of decomposition of starch is very low (Sofyan, 2003).

Crude fiber content of fermented rice bran was significantly (P<0.01) decreased (9.09%) compared to total crude fiber in unfermented rice bran (17.78%). Earlier works by Ofuya and Nwanjiuba (1990) showed successful degradation of cassava peel (a fibrous by-products of cassava tuber processing) by *Rhizopus sp*. Vig and Walia (2001) reported that that the contents of glucosinolates, thiooxazolidones, phytic acid and crude fibre declined by 43.1%, 34%, 42.4% and 25.5%, respectively, following inoculation by *Rhizopus oligosporus*. This was happened because of the ability of fungi to degrade fiber (Ofuya and Nwanjiuba, 1990; Iyayi and Losel, 2001). Further study by Iyayi and Aderolu (2004) showed that solid state fermentation of rice bran with *Trichoderma viride* was effective in reducing the fiber level in the wastes by between 35.00 and 40.00%. The increased protein and sugar and decreased fiber level obtained in previous study were an indication of the ability of *T. viride* to secrete cellulose enzyme which breaks the starch and non-starch polysaccharides to monomer sugars which were then easily metabolized. Istiqomah *et al.* (2010) also reported that fermentation process in complete feed silage by *Rhizopus sp* addition decreased the crude fiber and also increased the digestibility.

Calcium content in fermented rice bran was significantly (P<0.01) increased (0.14%) than unfermented rice bran (0.12%). The addition of chitin chitosan which had mucopoli saccharide will bind the inorganic salt, primarily calcium carbonate ($CaCO_3$), protein, and lipids. Chitin chitosan exhibited antibacterial activity towards various bacteria where, as the concentration of chitosan increased, its effectiveness also increased (Wang, 1992). Furthermore, chitosan affected the growth of the bacterial pathogens such as *B. cereus*, *P. aeruginosa*, *Salmonella sp.*, and *E. coli* (Khalaf, 2004).

Feed Consumption

Observation result of feed consumption increment was performed in Table 2.

Table 2. The amount and the average of feed consumption for 4 weeks

Treatment	Early	Week 1st	Week 2nd	Week 3rd	Week 4th	Average feed consumpt.,kg/h/d
Unfermented rice bran/control	41.20	41.20	41.20	41.20	41.63	41.29 ± 8.00[a]
Fermented rice bran	33.09	33.10	33.21	34.25	34.91	33.71 ± 7.08[b]

Table 2 describe that feed consumption increment in control diet (unfermented rice bran) were relatively stable for three weeks but increase only in fourth week. Meanwhile the feed consumption increment by using fermented rice bran as a flavor enhancer for 4 weeks were increase significantly (P<0.05). Feed consumption increment for 4 weeks in cattle by fermented rice bran diet was caused by the increase of palatability ration. During the fermentation processes, there is not only changes in nutritional value but also there is a change arising flavor because the formation of one or several chemicals compounds which released by fungi in medium fermentation which in this case is rice bran (Wizna *et al*., 2000 and Zhixiong *et al*., 2010).

Sofyan *et al.* (2008) reported that physical quality of fermented rice bran with *Rhizopus sp*. inoculums and chitosan waste addition has more fragrant flavor characteristic than the control bran. *Rhizopus oryzae* was capable in producing lipase which able to synthesize *citronellyl esters* compound as flavor forming component in the flavor of food or feed ingredients (Macedo and Lozano, 2003) while *Saccharomyces* producing the alcohol flavor (Thomas *et al.*, 2002) thereby increasing the flavor of the feed fermented.

Cattle Performance

Comparison of body weight gain between diet with fermented rice bran as a flavor enhancer and control diet (unfermented rice bran) for 4 weeks of observation are shown in Table 3.

Table 3. The mean of initial weight, final weight and body weight gain for 4 weeks

	Body Weight Estimation	
Average	Unfermented Rice Bran (Control)	Fermented Rice Bran
Initial body weight (kg)	377.22 ± 12.47	323.82 ± 59.35
Final body weight (kg)	378.79 ± 13.46	335.75 ± 60.39
Body weight gain (kg/head/4 weeks)	1.57 ± 2.15[a]	11.93 ± 3.30[b]

Based on Table 3 shows that the weight of cattle for 4 weeks with fermented rice bran treatments were significantly higher ($P<0.01$) equal to 11.93 kg/head or about 0.43 kg/head/day compared with control diet which only 1.56 kg/head, equivalent to 0.06 kg/head/day. The high of body weight gain additional on beef cattle which fed by fermented rice bran due to the increased feed consumption. The enhancement of this feed intake was caused by specific odor of fermented rice bran that could increase the flavor of feed with minerals and amino acid compounds which useful for cattle performance (Sereewatthanawut *et al.*, 2008).

Rice bran as major ingredient will supply nutrients for the fungi that will be a source of energy, thereby increasing the weight of cattle. Rice bran also supply the nutrients for the bacteria and provide the basic chemical elements for growth of cells (Prastiwi *et al*,, 2006). The addition of chitin chitosan waste as mineral sources had positive effect to the fermentative digestion in rumen because the mineral was used by rumen microbes to produce the amino acids, therefore it could increase the body weight gain (production).

Feed Conversion

To get the value of the benefits of a ration is physiologically and economically, used feed conversion value obtained by dividing the number of rations consumed with the body weight gain produced during the experiment in the same units.

From the calculation of feed intake and growth rate, then feed conversion ratio can be seen that the fermented rice bran as a flavor enhancer resulted 28.24 while the control diet 30.53. This feed conversion ratio means that with unfermented rice bran (control diet), to get 1 kg of weight gain increment need to consumed feed as many as 30.53 kg, while by fermented rice bran treatment the only need 28.24 kg of feed.

This improvement was expected because during the production of fermented rice bran, during fermentation with *Rhizopus sp*., there were formed many enzymes which help the digestion and the formation of unindentified growth factor/UGF (Kompiang and Supriati, 2001).

CONCLUSIONS

The growth of cattle given fermented rice bran for four weeks of observation can produce more efficiently in a conversion rate of feed and significantly improve the average daily gain (0.43 kg/head/day) than cattle with unfermented rice bran (0.06 kg/head/day). Based on this results, it can be concluded that to increase the use of rice bran in diet, it is suggested first the rice bran to be processed through fermentation with *Rhizopus sp.* because it caused changes in texture and flavor of feed ingredients that made fermentation products more attractive, easily digestible, and nutritious for the cattle.

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