The Effect of Ragi Tape Fermentation Products in Diets on Nutrients Digestibility and Growth Performance of Bali Drake

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ABSTRACT

This research was carried out to study the effect of fermentation ragi tape products (rice bran, pollard, soybean-hull, and cocoa-pod fermented) in diets on nutrients digestibility and growth performance of Bali drake aged 4-10 weeks. The design of experiment used a completely randomized design (CRD) with nine treatments and six replications. There were 10 birds in each replication with relative homogenuous body weight (359±12,75 g). The diets were formulated to 17% crude protein and 2900 kcal ME/kg as a control diet (A), diets with 15% rice bran (B), 15% rice bran fermented by 0,30% yeast culture (C); 15% pollard (D), 15% pollard fermented by 0,30% yeast culture (E), 15% soybean-hull (F), 15% soybean-hull fermented by 0,30% yeast culture (G), 15% cocoa-pod (H), and 15% cocoa-pod fermented by 0,30% yeast culture (I), repectively. Diets and drinking water were provided *ad libitum*. Variables were observed in this experiment are nutrient digestibility (protein, crude fibre, and energy), feed consumption, live weight gains (LWG)s, and feed conversion ratio (FCR). The results of this experiment showed that fermented rice bran, pollard, and soybean hull in diets, resvectively did not effect on feed consumption, but increasing LWGs compared with unfermented feeds. The nutrient digestibility (protein, crude fibre, and metabolizable energy) and FCR however decreased. Birds offered fermentation ragi tape products (treatment C, E, G, and I) had higher (P<0,05) nutrient digestibility and growth performance compared with those of control and unfermented products. It is concluded that inclusion of fermentation ragi tape products (rice bran, pollard, soybean-hull, and cocoa-pod fermented) in diets could increase nutrient digestibility and growth performance of Bali drake aged 4-10 weeks.

Key words: yeast culture, dietary fiber, digestibility, performance of drake

INTRODUCTION

Aspergillus oryseae (*AO*) and *yeasts*, particularly *Saccharomyces cereviseae*, have been used as probiotics by many workers (Piao *et al.*, l999). Both *Aspergillus spp*. and *Saccharomyces* belong to the *Ascomycoyina* subdivision and have many industrial applications in the brewing, destilling, ang baking industries (Han *et al.,* 2001).

Yeast culture product, which have some fermentation ability consist of yeast (*S. cerevisae*) and the media which the yeast grew on (Bidura *et al.*, 2008a). Piao *et al*. (l999) showed that 0,10% yeast added to a diet could reduce animal wastes, and similar results were reported by Park *et al*. (l994). But, Piao *et al*. (l999) reported no significant improvement in weight gain, feed intake, and feed efficiency with 0,10% yeast culture. Feeding live yeast to broiler breeder reduced colonization of salmonela in their ceca and improved posphorus utilization in growing chickens.

The potensial of forages by-products as energy sources for poultry depends considerably on such factors as cell wall content, degree of microbial fermentation in the large intestine, and extent of absorption and utilization of the volatile acids produced (Kahlique *et al.,* 2003). Agro-industry by-product is one such product abundantly and cheaply available during the season. These toxic factors are trypsin inhibitor, lectin (hemaglutinin), phytic acid as phytate, and crude fiber. These anti-nutritive factors have been reported to reduce feed intake and depress performance of poultry.

Knudsen (2001) reported that dietary fiber (DF) has been defined as the complex macromoleculer substances in food plants that are not degraded by mammalian digestive enzymes. With the exception of lignin, all of the materials called DF are carbohydrates in nature. DF is thought to mediate protective effects on the colonic epithelium through their fermentation products and fecal bulking capacity (Wang *et al.*, 2003).

Ration high fiber resulted in a lowered rate of lipogenesis and tendency of an increased capacity to utilize acetyl-CoA in pigs (Zhu *et al.*, 2003). Non starch polysaccharide (NSP) are the carbohydrate components of DF and predominant substrates for anaerobic fermentation. Non starch polysaccharide can be broken down by microflora permanently colonizing the gastrointestinal tract and their breakdown in all non ruminant mainly occurs in the hindgut by microbial fermentation (Weng *et al*., 2003).

Among the cell wall polysaccharides known as nonstarch polysaccharides (NSP) are celluloses, pectins, and oligosaccharides can not be degraded enzymitically in the digestive systems of the birds due to the lacking of enzymes degrading the NSP in their digestive systems (Choct, 2002). Beta-glucans and pentosans decrease digestion and absorbtion of nutrient due to their effects on the intestinal viscosity (Ikegami *et al*., 1990). Most of the recent studies focus on the effect of the bacterial and fungal enzymes used in cereal based diets.

More than 50% of phosphorus in other plants seeds in the phytate form, which is poorly available in digestive tract of monogastric animal (Ilyas *et al*., l995). Phytic acid found in vegetable feed sources affects protein and amino acid digestibilities negatively by preventing activities of the proteolytic enzymes such as pepsin/trypsin. Futhermore, phytic acid has a higher P content and chelating ability and phytate form of phytic acid diminishes the availability of Ca and P (Pointillart, 1991). Monogastric animal can not use of phytin phosphorus due to lacking of phytase enzyme in their digestive systems and consequently phytin posphorus is mostly excreted in the faeces.

Therefore, it is sugested that fermentation of feedstuff by yeast can be used in order to alleviate negative effect of phytic acid. Gut microfloral enzymes are beneficial to the nutrition of the host because they increase the digestion of nutrients, especially in the lower intestine. Previous experiments showed that the inclusion of microorganisms in diets improved feed conversion efficiency and digestibility (Chen *et al*., 2005).

The objective of this study was to determine effect of fermentation ragi tape products (rice bran, pollard, soybean-hull, and cocoa-pod fermented) in diets on nutrients digestibility and growth performance of Bali drake.

MATERIALS AND METHODS

Animal Experiment

Five hundred fourty of Bali drake 4-wk-old were randomly allotted to colony wire-floored cages, 10 birds per cages. A 500 ml plastic muge/bottle equipped was placed of each cage. Experimental diets and drinking water were provided *ad libitum* during the entire experimental period (for a 6-week periods). Body weight and feed intake were recorded weekly.

Ration Experiment and Drinking Water

The nine experimental diets (Table 1) based on corn-soybean meal were as follows : a control diet (A); diet with 15% rice bran (B); 15% fermented pollard by 0.30% yeast culture (C); with 15% pollard (D), 15% fermented pollard by 0.30% yeast (E), 15% soybean hull (F), 15% fermented soybean hull by 0.30% yeast (G), 15% cocoa-pod (H), and 15% fermented cocoa-pod by 0.30% yeast cultur (I), respectively. The basal diets (Table1) were formulated based on meet or exceed nutrient requirement (NRC, 1994). All diets were iso-energy (2900 kcal ME/kg) and iso-protein (CP:17%). Through all the experimental period, birds were allowed *ad libitum* acces to feed and water. The composition of ration compiler substances and nutrient which is used in diets can be seen in Table 1.

Saccharomyces cereviseae

Ragi tape is brand name of *Saccharomyces cereviseae* culture produced locally by fermenting rice brand with *S. cereviseae*. *Saccharomyces cerevisieae* from ragi tape which used is common yeast used in ”tape” making title ”Na Kok Liong”, ensiled in number 26895.

Fermentation of Feedstuff

Fermentation of rice bran, polard, soybean hull, and cocoa-pod ingredient were prepared from the same batch approximately 0.3% yeast culture (“ragi tape”) were added to each feeding. Following the fermentation, water was added to bring the product to 50% content and fermented for 6 days. After fermentation, fermented of rice bran, polard, soybean hull, and cocoa-pod was dried at 45^0C for 6 h.

Retention and Excretion of Nutrients

After three weeks of feeding trial, 6 birds from each treatment were randomly assigned to individual metabolic cages to determine retention and excretion of dietary nutrients. Excreta were collected for 6 days. Foreign substances (feathers, scurf, etc) mixed in the collected excreta were removed before drying at 60^0C for 48 h and subsequent grinding. Ration and feces were analyzed by AOAC (l994) procedures for proximate components. The retention of nutrients was calculated by dividing the amount of retained nutrient (ingested nutrient minus excreted nutrient) by the amount of ingested. To determine the concentration of Ca and P in feeds and excreta, samples were dry ashed (AOAC, 1994) and assayed at the specific wave lengths for each element.

Analysis of Nutrients

Dry matter (DM), organic matter (OM), CP and CF were done according to the Assocciation of Official Analytical Chemists (l994). The CP content of the diets was determined using the Kjeldahl procedure (AOAC, 1994). Crude fibre of the feeds was determined using procedure of Van Soest *et al.* (l991).

Statistical Analysis

All data were analyzed by a one-way analysis of variance test (Steel and Torrie, 1989). Statistical significances among treatment means were determined by method of New Multiple Range Test of Duncan when the F value was significant at 5 % level.

Table 1. Formula and chemical composition of diets of growing Bali drake aged 4-10 weeks (as-fed basis)

Ingredient (%)	Treatment Diets[1)]								
	Control	B	C	D	E	F	G	H	I
Yellow corn	68.70	63.20	63.20	67.50	67.50	60.00	60.00	58.10	58.10
Soybean meal	19.70	1.60	1.60	11.30	11.30	1.50	1.50	1.90	1.90
Pollard	11.30	5.90	5,90	15.00	**15.00***	3.36	3.36	6,20	6.20
Fish meal	0	14.00	14.00	6.10	6.10	13.9	13.9	14.60	14.60
Rice bran	0	15.00	**15.00***	0	0	3.30	3.30	3.00	3.00
Soybean hull		0	0	0	0	15.00	**15.00***	0	0
Cocoa-pod	0	0	0	0	0	0	0	15.00	**15.00***
Palm oil	0	0	0	0	0	2.64	2.64	0,90	0.90
NaCl	0.1	0.10	0.10	0.10	0.10	0.10	0.10	0,10	0.10
Mineral mix	0.2	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100	100	100	100	100
Chemical composition[2)]									
ME (kcal/kg)	2903	2903	2903	2904	2904	2901	2901	2903	2903
Crude protein (%)	17	17	17	17	17	17	17	17	17
Eter extract (%)	6.43	7.46	7.46	8,07	8.07	7.10	7.10	6.32	6.32
Crude fiber (%)	4.04	8.02	8.02	7.25	7.25	7.93	7.93	8.06	8.06
Calsium (%)	1.57	1.26	1.26	1.55	1.55	1.55	1.55	1.55	1.55
P-available %)	0.63	0.58	0.58	0.64	0.64	0,64	0.64	0.64	0.64
Argynine (%)	1.28	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Lysine (%)	1.21	1.16	1.16	1.21	1.22	1.21	1.22	1.22	1.22
Metionine (%)	0.42	0.37	0.37	0.39	0.40	0.39	0.40	0.40	0.40
Triptophan %)	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18

Note : *) : Feeding ingredient fermented by 0.30% yeast culture before using in diets; [1]The ration without rice bran, pollard, soybean hull, cocoa-pod, and yeast as a control (A), ration with 15% rice bran (B); 15% fermented rice bran by 0.30% yeast culture (C); with 15% pollard (D), 15% fermented pollard by 0.30% yeast (E), 15% soybean hull (F), 15% fermented soybean hull by 0.30% yeast (G), 15% cocoa-pod (H), and 15% fermented cocoa-pod by 0.30% yeast cultur (I), respectively; [2]According to the calculation of Scott *et al.* (l982).

RESULTS AND DISCUSSION

Nutrient digestibility and metabolizable energy of unfermented feeding (UFF) and fermented feeding (FF) ingredient are showed on Table 2. Digestibility of crude protein, and crude fiber were slightly increased significantly different (P<0.05) by the fermentation.

The metabolizable energy on birds offered FF was increased than metabolizable energy on birds was offered UFF (Table 2). Fermented of feeding ingredient were caused increased of crude protein and crude fibre digestibilities, resvectively than UFF ingredients.

The result indicated that all of nutrient digestibility of fermented feeding (rice bran, pollard, soybean hull, cocoa pod, and poultry feather meal) by yeast culture were increased significantly (P<0.05) different than UFF.

The average of final body weight and LWGs during six weeks observation at birds which having the ration control (A) are 1165 g/birds and 715 g/birds/6 weeks, respectivelly (Table 3). The average of final body weight and LWGs of the birds having ration with UFF ingredients e.g. rations with 15% rice bran (B); with 15% pollard (D), 15% soybean hull (F), and 15% cocoa-pod (H), respectevely were not affect significantly different (P>0.05) both on final body weight and body weight gains. But, the bird were offered FF ingredient e.g. 15% fermented rice bran by 0.30% yeast culture (C); 15% fermented pollard by 0.30% yeast (E), and 15% fermented soybean hull by 0.30% yeast (G),respectively were increased significantly different (P<0.05) than birds were offered UFF and control diets.

At the end of the experiment (at 42 days of age) the body weight gain was significantly (P<0,05) increased in the group FF (fermented fed) diet compared to groups that received control and UFF (unfermented fed). In general, the body weight gains were tended to decrease with used of cocoa-pod (treatment H and I) which is probably due to high theobromin, tannin, and high fiber contents on the cocoa-pod used in experiment.

Feed consumption was not affected by fermentation of feed (FF) in diets. The averages of feed consumption between in treatments B, C, D, E, F, G, H, and I were not significantly different (P>0.05) than control groups.

The average of feed conversion ratio (feed: gains) during six weeks observation at birds which having the ration control (A) is 5.64/birds (Table 3). The average of feedconversion ratio (feed: gains) of the birds having ration FF were decreased significantly (P<0.05), both than control and UFF groups. Feed conversion ratio on treatment A,B, D, F, and H groups were higher than other groups.

Table 2 showed chemical composition of unfermented feeding (UFF) and fermented feeding (FF) ingredient. Crude protein, crude fiber, and ME content were slightly increased by the fermentation, on the other hand, the content of GE was decreased by fermentation. These results indicated that carbohydrates other than fibres were used for microbial growth and the reduction of nitrogen free extract resulted in increased concentration of the other components. Yi *et al.* (l996) reported that supplementation of microbial in diets improved N retention in broiler chickens and *in vitro* digestibility of vegetable protein. Also, Chen *et al.* (2005) reported that addition of 0.20% complex probiotic (*L. acidophilus* and *S. cerivisae*) in basal diets were increased digestibities of DM and N.

According to Ilyas *et al.* (l995), when the fermented product was suplemented in formula feeds, phytase in the fermented product might partly degrade the phytate in order ingredient in the digestive tract. The fermented product is possibly used as a phytate-free protein source of feed, which contains high available phosphorus. It's was reported that fermentation of soybean meal by *Aspergillus usami* reduced phytate phosphorus levels.

Ilyas *et al.* (l995) reported if the enzyme effectively degrades phytase in the digestive tract, phytase in fermented soybean meal can be degraded phytate from other ingredients of ration. The reasons for the reduction both of excreta protein and energy by the feeding fermentations may be related to the fact that fermentation process may improve dietary protein and energy digestibility (Chiang dan Hsieh, 1995). Dilaporkan juga bahwa a dosage of 0,25g of probiotics/kg of diet is needed to maximize growth performance during both the starter and finisher periods. A higher dosage (approximate 0.5 g/kg diets) is needed to minimize litter ammonia production.

Ration with high dietary fiber caused a decrease metabolizable energy. It's couse that the passage time of digesta was shortened and the fecal excretion was increased in broiler. Cao (2001) reported that 1.5-3.5% dietary cellulose enhaced growth and metabolizable energy retention of 7-15 d old chicks, but the levels of more than 5% suppressed the growth and metabolizable energy. Denbow *et al*. (1995) reported that supplementary microbial phytase improves the bioavailability of dietary.

The use of 15% rice bran, pollard, soybean hull, and cocoa-pod ingredient in diets, respectively were not effect on final body weight, body weight gains, feed consumption, and feed conversion ratio compared than control diets. Fermentation feedstuff by yeast culture before using in ration was increased final body weight, body weight gains, feed consumption, and feed conversion ratio. Fermentation process by ragi which contains *Saccharomyces cerevisiae*, according to Wallace dan Newbold (1993), *Saccharomyces cerevisiae* can improve crude fibre digestibility on the ceca of birds to become volatile fatty acid (acetate, provionate, and butirate acid). Volatile Fatty Acid (VFA), according to Sutardi (1997) are energy sourches both to birds and ceca microorganism. Piao *et al*. (l999) reported that used of 0,10% *yeast* (*Saccharomyces cerevisae*) in diets were increased body weight gains, feed efficiency, and absorption of nutrient in broiler, and were decreased N and P excretion in manure. Park *et al*. (l994) suggested that body weight gain and feed efficiencies were significantly improve by the addition of 0,10% *yeast culture* in diets of broiler. Bidura (2008) reported that birds were offered fermented diets coaused body weight, carcass weight, and performance (Warmadewi *et al*., 2008) of drake were increased.

Table 2. The effect of fermented rice bran, pollard, soybean hull, and cocoa-pod by Yeast culture on nutrient digestibilities (% dry matter), respectively

Feeding Ingredient	Digestibility (%)			ME (kcal/kg)
	DM	Crude Protein	Crude Fibre	
Rice bran				
• Control (UFF)	58.03 [b]	64.59 [b]	43.70 [b]	1460 [b]
• Yeast culture (FF))	62.06[a]	88.62 [a]	57.06 [a]	1897 [a]
Pollard				
• Control (UFF)	66.69 [b]	65.97 [b]	35.09 [b]	2305 [b]
• Yeast culture (FF)	72.40 [a]	84.93 [a]	60.85 [a]	2517 [a]
Soybean hull				
• Control (UFF)	63.71 [b]	61.09 [b]	48.96 [b]	2061 [b]
• Yeast culture (FF)	73.63 [a]	82.83 [a]	66.79 [a]	2567 [a]
Cocoa-pod				
• Control (UFF)	52.32 [b]	47.31 [b]	44.37 [b]	1656 [b]
• Yeast culture (FF)	67.93 [a]	60.99 [a]	63.07 [a]	2258 [a]
Poultry feather meal				
• Control (UFF)	46.29 [b]	42.10 [b]	13.32 [b]	1760 [b]
• Yeast culture (FF)	61.41 [a]	74.39 [a]	35.07 [a]	2341 [a]

Note: The different superscript at the same column in the feedstuff, respectivelly is significantly different (P<0,05) ; UFF = Unfermented feeding; FF = Fermented feeding by 0.30% yeast culture

Table 3. The effect of fermentation ragi tape products (rice bran, pollard, soybean hull, and cocoa-pod, respectively) in diets on performance of Bali drake eged 4-10 weeks

Variabel	Treatments[1)]									SEM[2]
	A	B	C	D	E	F	G	H	I	
Final body weight (g/birds)	1065[c3)]	1046[c]	1225[b]	1058[c]	1306[a]	104[c]	1295[a]	1018[c]	1035[c]	26.79
Body weight gains (g/birds/6 weeks)	715[c]	694[c]	873[b]	708[c]	953[a]	690[c]	943[a]	666[c]	682[c]	25.08
Feed consumption (g/d/birds)	4022[c]	3945[a]	4240[a]	4036[a]	4152[a]	3914[a]	4112[a]	3784[a]	3572[a]	278.4
FCR (feed/gains)	5.64[a]	5.69[a]	4.88 [c]	5.70[a]	4.36[d]	5.68[a]	4.36[d]	5.68[a]	5.24[b]	0.137

Note : [1] The ration without rice bran, pollard, soybean hull, cocoa-pod, and yeast as a control (A), ration with 15% rice bran (B); 15% fermented rice bran by 0.30% yeast culture (C); with 15% pollard (D), 15% fermented pollard by 0.30% yeast (E), 15% soybean hull (F), 15% fermented soybean hull by 0.30% yeast (G), 15% cocoa-pod (H), and 15% fermented cocoa-pod by 0.30% yeast cultur (I), respectively; [2]*Standard Error of The Treatment Means*; [3]The different superscript at the same row is significantly different (P<0.05)

Biofermentation of rice bran, pollard, soybean hull, and cocoa-pod fed ingredient by ragi (yeast culture) and it's addition to the diet had better nutrient digestibilities, because *Saccharomyces cerevisae* in the gastrointestinal tract can part of an probiotics sourches. *Saccharomyces cerevisae* as part of an probiotics were increased retention of mineral Calsium, Posphor, and Mangane (Nahashon *et al.,* l994; and Piao *et al.,* l999). Also, Piao *et al.* (l999); Sibbald and Wolynetz (l986), suggested that probiotics in the gastro intestinal tract can improve protein and energy retention on the body of birds. Most of the recent studies focus on the effect of the bacterial and fungal enzymes used in cereal based diets. These fungal are effective in degrading of the complex compounds such as b-glucans and arabinoxylans (Bedford and Classen, 1992).

Chen *et al.* (2005) reported that dietary supplementation of complex probiotic increased the body weight gain and decreased fecal NH_3-N concentration, and slightly improved digestibility of nutrients. Fermented feed product to the rations coused numerical increases in the body weight gain. This study is consistent with some studies which indicated that fermented diets effect performance positively (Bidura *et al*., 2008b; Warmadewi *et al*., 2008)). This case can be attributed to the positive effects of fermented feed product on phytates and protein. Wu *et al.* (2005) reported that supplementation of *Aspergillus xlanase* can improve the performance of the broilers fed the wheat-based diet.

The final body weight, body weight gains, feed consumption, and feed conversion ratio in the birds were offered 15% rice bran, pollard, soybean hull, and cocoa-pod fed ingredients were not different than control. But, there were indicated decrease than control groups. It's coused that the content of crude fibre from that's feed was difficulty to digestibilities by gastro intestinal enzymes. According to Siri *et al.* (1992), increasing of crude fibre in diet to become decrease energy digestibilities and lipida absorption. Cao *et al.* (2003) reported that body weight gain, nitrogen utilization and retention time of the diet in the digestive tract decreased significantly while the total microflora count in the caecal contents increased significantly in the group fed 10% dietary cellulose compared to group fed 3.5% dietary cellulose. The inclusion of fiber sources reduced the maintenance energy requirement and the fecal energy excretion was increased with the increase of crude fibre in diets. According to Wang *et al*. (2004), feeding dietary fiber caused an increased daily amount of methane and thus an additional energy loss from methane production. The pig fed on diets with the inclusion of either dietary fiber or resistant starch had a higher maintenance requirement. A higher daily DM intake resulted in a higher energy loss from feces. The decreased ileal and fecal digestibility of energy were found in pigs fed on diets with the inclusion of dietary fiber.

Ration which high crude fibre can couse rate of passage diets in the gastro intestinal tract were increased rather than ration which low crude fibre content. It's couse nutrient in diets was unabsorbed and there were exit to feces (Suhendra, l992). Also, Linder (l985), suggested that fraction of crude fibre i.a. pectin can chelate bile salt and lipid to throw away in excreta. There are some experiment were support this data. Reported by Bakhit *et al.* (l994) that used of soybean hull in diets were decreased performance of broiler and carcass weight (Bidura *et al*., 2008b). Cao *et al*. (2003) reported that chickens fed 10% dietary cellulose had significantly increased counts of uric-acid degradative bacteria. It has been reported that passage time of digesta was shortened and the fecal excretion was increased in broiler, and the caecal flora was increased in turkey dietary cellulose. These studies indicated that gastrointestinal transit time of digesta might be increase and gastrointestinal flora would be rather hard to stay there, when without undigestible material in the intestine.

CONCLUSIONS

It was concluded that used of fermentation ragi tape products (rice bran, pollard, soybean-hull, and cocoa-pod fermented) in diets could increased nutrient digestibility and growth performance of Bali drake aged 4-10 weeks. Further researches also needed to determine the optimum addition level of the *Shaccaromyces cerevisae* as probiotics sourches in this study for both in basal diets and low quality diets on Bali drake.

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