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Response of Broiler Fed Cocoa Pod Fermented by *Phanerochaete chrysosporium* and *Monascus purpureus* in the Diet

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Abstract: An experiment was conducted with 200 unsexed broilers of 3 days old of the Arbor Acres strain to evaluate utilization of cocoa pods fermented by *Phanerochaete chrysosporium* and *Monascus purpureus* in the diet on the performance of broiler. This study involved a Completely Randomized Design (CRD) with 4 treatments (0, 5, 10 and 15% of fermented product in the diets) and 5 replicates per treatment. Diets were iso nitrogenous (22% crude protein) and iso caloric (3000 kcal/kg diet). Measured variables were performances (feed consumption, weight gain, feed conversion, carcass percentage and total cholesterol). Increasing cocoa pod fermented levels in the diets increased feed consumption, weight gain and carcass percentage but decreased ($p<0.01$) feed conversion and blood cholesterol). In conclusion, up to 15% of cocoa pod fermented by *Phanerochaete chrysosporium* and *Monascus purpureus* could be included for broiler diet to increase performances and decreased 35.65% cholesterol level.

Key words: Cholesterol, fermented cocoa pod, *M. purpureus*, *P. Chrysosporium*, performance

INTRODUCTION

Cocoa pods has good potential used as animal feed, but its application as poultry feed is still small. In West Sumatra the total area of cocoa plantations reached 61.000 hectares and the cocoa pods production in 2010 as many as 49.769 tons (Department of Agriculture, 2011). Composition of fruit cocoa contain 73-75% cocoa pods and 22-25% grain placenta (Wawo, 2007), so that estimated cocoa pod in 2010 approximately 36.000 tons. Nutrient content of cocoa pods containing 11.71% crude protein, 11.80% fat, 34.90% BETN but high in crude fiber 33.79% (cellulose 12.07% and lignin 15.13%), tannin 0.13% and theobromine 0.17%, so that its utilization as animal feed limited, especially poultry. Cocoa pods can be used in broiler diet just 5% (Nuraini, 2008), because of their limiting factor such as: lignin, cellulose and anti nutrients tannin and theobromine.

Therefore, to improve the quality of cocoa pods as poultry feed, must reduced the content of lignin, cellulose, theobromine and tannin through fermentation by *Phanerochaete chrysosporium*. According to Howard *et al*. (2003) and Kersten and Cullen (2007) *Phanerochaete chrysosporium* can degrade lignin and its compounds effectively by producing extracellular peroxidase enzymes such as lignin peroxidase (LiP) and manganese peroxidase (MNP). Fermented product by *Phanerochaete chrysosporium* followed with fermentation by *Monascus purpureus* to produced monacolin. Monacolin is a carotenoid pigment produced by *Monascus purpureus* also known as lovastatin which is an agent hypercholesterolemia (Su *et al*., 2003). Utilization of fermented product by *Monascus purpureus* 30% in the diet of laying hens reduced cholesterol 46.63% (Nuraini *et al*., 2012).

Nutrient quality of cocoa pods after fermentation by *Phanerochaete chrysosporium* and followed by *Monascus purpureus* increased if compare with before fermentation. Protein content 21, 69%, crude fiber 14.45% and monacolin 400,71 mg/kg. So that this experiment want to study the effect of feeding fermented product by *Phanerochaete chrysosporium* and followed by *Monascus purpureus* (high carotenoid monacolin) in the diet on performance of broiler.

MATERIALS AND METHODS

Fermented feed preparation: Culture of *Phanerochaete chrysosporium* and *Monascus purpureus* were reconstituted and subcultured were made with using potatoes dextrose agar for 4 days. The inoculated subcultures were kept at room temperature. The fermented cacao pod was prepared as per the procedure described by Nuraini *et al*. (2013). The substrates contain 80% cocoa pod with 20% tofu waste, added aquades (water content 60%). The substrates was autoclaved at 121°C for 30 min. The cooled fermented substrate was inoculated with 7% inoculum of *Phanerochaete chrysosporium* and incubated for 8 days. After incubation, the fermented product were dried in oven at 80°C for 2 h. Followed fermentation with 7% inoculum of *Monascus purpureus*, incubated for 8 days. After incubation, fermented products were dried in oven at 60°C for two days. The

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dried fermented products were ground in a grinding mill and stored until mixed with the other feedstuff. Own diets were formulated from ingredients such as corn, soybean meal, fish meal, rice bran, fermented product by *Phanerochaete chrysosporium* and followed by *Monascus purpureus*, coconut oil and $CaCO_3$.

Birds housing and feeding: Two hundred of three days old CP 707 broiler chicks were study in this experiment. The chicks were individually weighed and randomly selected and allotted to each of the four different level of fermented product by *Phanerochaete chrysosporium* and *Monascus purpureus*. The experimental design used was Completely Randomized Design (CRD) with 4 treatments were: 0, 5, 10, 15% fermented product (FP) in the diet and 5 replicates of ten chicks each. All the chicks were provided with uniform feeder and waterer space, the floor and were reared under standard management condition throughout the experimental period of five weeks. The birds were given the diets with 22% crude protein (isonitrogenous) and 3000 ME kcal/kg feed (isocaloric). Feed and water were provided for *ad-libitum*. The variable observed were feed consumption (g/bird), weight gain (g/bird), feed conversion, carcass (%), blood cholesterol (mg/dl). Data on body weight and feed intake were recorded every week.

Statistical analyses: All the data obtained were subjected to Completely Randomized Design (CRD) as per the procedure of Steel and Torrie (2000). The significance differences occurred were compared using Duncan Multiple Range Test (DMRT) at probability of 0.05 and 0.1% levels.

RESULTS

The effect of feeding fermented product by *Phanerochaete chrysosporium* followed by *Monascus purpureus* on broilers performance are presented in Table 1. Increasing utilization fermented product in the broiler diet were significantly ($p<0.05$) affected feed consumption, weight gain and feed conversion and blood cholesterol.

DISCUSSION

Feed consumption of broiler was the highest at the treatment using 15% fermented product, it showed that the product fermented by *Phanerochaete chrysosporium* followed by *Monascus purpureus* preferred (palatable) up to 15% in the diet; even though with reduction of corn and soybean meal in each of these treatments. In accordance with the opinion of Murugesan *et al.* (2005), fermentation products have a preferred flavor and has a few vitamins (B1, B2 and B12) that are preferred when compared to original material.

High body weight of broiler, it means high feed nutrient in the diet which use to produce meat, so it can increase weight gain. In addition, highest body weight gain in treatment D (15% FP) compared to treatment A (0% FP) is caused by feed consumption that was also higher at that treatment. High value of feed intake mean, the amount of nutrients consumed and digestion also increase, especially protein and energy, caused high value of body weight. According to Rizal (2006) body weight affected by nutrient content in the diet and feed intake.

It also due to the product fermented by *Monascus purpureus* produced unsaturated fatty acid were oleic acid (omega 9), linoleic acid (omega 6) and linolenic acid (omega 3) (Lin *et al.*, 2005). Fermentation cacao pods by *Phanerochaete chrysosporium* and *Monascus purpureus* produced oleic acid 1.95%, linoleic acid 2.14% and linolenic acid 0.40%. Rizal stated (2006) that the essential fatty acid for growth of poultry just linoleic acid, if its utilization is more than 1% in the diet increased growth of broiler.

Lower feed conversion ratio at treatment D (15% FP) than in treatment A is caused by feed consumption and weight gain also differ significantly ($p<0.05$). According to Varkoohi *et al.* (2010), feed conversion ratio is the ratio between feed intake in producing a number of meat. Feed conversion can be used as a picture of the production coefficient, the smaller value mean more efficient use of feed to produce meat.

The lowest level of blood cholesterol of broiler in treatment D compared to other treatments, associated with use of fermented product rich monacolin. Increasing fermented product by *Monascus purpureus* in the diet caused the higher content of carotenoids

Table 1: Broiler performance feeding fermented product (FP)

	Diet			
Parameter	0% FP (A)	5% FP (B)	10% FP (C)	15% FP (D)
Feed consumption (g/bird)	2430.95±2.45^{c}	2460.38±2.30^{b}	2495.06±2.51^{a}	2526.60±2.45^{a}
Body weight gain (g/bird)	1227.64±2.35^{c}	1260.38±2.34^{c}	1300.60±2.30^{b}	1350.51±2.39^{a}
Feed conversion	1.98±0.35^{a}	1.95±0.25^{ab}	1.92±0.30^{bc}	1.87±0.27^{c}
Carcass (%)	68.24±1.38^{c}	70.05±1.25^{bc}	71.40±1.25^{ab}	72.69±1.22^{a}
Blood cholesterol (mg/dL)	150.20±2.05^{a}	138.60±2.12^{b}	136.40±2.09^{bc}	134.20±2.15^{c}

Means in the same row with different superscript differ significantly ($p<0.05$) PF: product fermented

monocolin. Monacolin is hyphocholesterolemia agent. According to Erdogrul and Azirak (2004) red yeast rice (fermentation by *Monascus purpureus*) produced monacolin that can inhibit the action of the enzyme-CoA reductase Hydroksimetyl Glutaryl (HMG Co-A reductase), that play a role in the formation of mevalonat in the synthesis of cholesterol, so that cholesterol is not formed.

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Conclusion: Increasing fermented product by *Phanerochaete chrysosporium* and *Monascus purpureus* in the diet improved the performance and meat quality of broiler. Feeding fermented product up to 15% in broiler diet obtained 1350.51 g/bird body weight, feed conversion ratio 1.87, reduced meat cholesterol 23.88%.

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