

Palm Polysaccharides in the Diet of Broilers Challenged Against *Escherichia coli*: A Preliminary Study

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ABSTRACT

The use of palm polysaccharides in broiler diet as a feed additive has recently been reported with promising results. A study was conducted to determine the use of palm polysaccharides in broiler diets when the birds were challenged with *E. coli*. A total of 32 unsexed broilers, with the similar body weight (1400-1480 g) was selected and used in this study as experimental birds. The birds were kept in the individually metabolism cages for 2 weeks. Feed and water were available at all times. The diet was formulated to meet the nutrients need for grower chickens. Four different types of feed additives (Control, palm kernel polysaccharides, copra polysaccharides, antibiotic avilamycin), with and without *E. coli* challenge were used in this study. The birds were challenged with *E. coli* for three consecutive days (days 8 to 10), after a week of adaptation period. A completely randomised factorial design was used with the first factor is feed additive (Control, palm kernel polysaccharides, copra polysaccharides, antibiotic avilamycin), the second factor is two types of *E. coli* challenge (with or without *E. coli* challenge) and four replications. Differences among treatments found were further tested with Tukey test. The results indicated that the supplementation of feed additives (palm kernel polysaccharides, copra polysaccharides and avilamycin) improved body weight gain, FCR and excreta dry matter. The birds challenged with *E. coli* produced lower body weight gain and feed intake. Interaction between type of feed additives and *E. coli* challenge was found in body weight gain, feed intake, FCR and excreta dry matter. In conclusion, feed additives improved the quality of the diet and *E. coli* challenge had detrimental effect on bird performance. There was an interaction between type of feed additives and *E. coli* challenge on body weight gain, feed intake, FCR and excreta dry matter.

Key Words: Palm Polysaccharides, *E. coli*, Broilers

INTRODUCTION

Indonesia has been the largest palm oil producer and the second largest coconut producer in the world. This may indicate that large amount of byproducts was produced from oil extraction of these two agricultural products. Palm kernel meal and copra meal are byproducts of these palm trees that intensively studied in many palm oil and coconut – producing countries. However, studies in this area were mainly related to the effort of improving their quality as feed ingredients.

Of the fractions of nutrients present in palm kernel meal and copra meal, carbohydrates was the main component (Knudsen 1997). Palm carbohydrates have been reported to mainly in the form of non-starch polysaccharides, being 81% in palm kernel meal and 42.2% in copra meal (Knudsen 1997). Of the total non-starch polysaccharides in palm kernel meal, 70% was mannose-based polysaccharides (linear mannan), 12% cellulose and 6% xylane (Duesterhoft et al. 1991), while in copra meal was. 26% mannan, 61% galactomannan and 13% cellulose (Balasubramaniam 1976). This indicates that polysaccharides in these two agricultural byproducts were mannose based or mannan.

Due to the fact yeast mannan has been successfully proven to be prebiotic over the last three decades (Lyons 2002), mannose based polysaccharides present in these byproducts may also have the same properties as found in yeast mannan. Early study of Fernandez et

al. (2000) indicated that the population of pathogenic bacteria decreased in the digestive tract of broilers when the birds were fed palm kernel meal. Sundu & Damry (2008) reported that the use of mannose based polysaccharides from copra meal in broiler diets increased body weight of birds. Accordingly, a study was conducted to determine the effect of polysaccharides from these two byproducts on broiler performance and moisture content of excreta.

MATERIAL AND METHODS

Mannan extraction

A method of Kusakabe & Takashi (1988) was used to extract mannose based polysaccharides from copra meal and palm kernel meal. Sixteen litres of 20% NaOH concentration was added to 2 kg of palm kernel meal or copra meal in a bucket. The mixture was occasionally stirred for 24 hours at room temperature. The slurry was then filtered through a cloth bag. The filtrate was neutralized with 12 N H₂SO₄ until the pH solution is about 5.5. Resultants precipitate (mannose based polysaccharides) collected by centrifugation, was dialysed against tap water to remove salts. The leftover residue was as a copra mannan as it was analysed by Kusakabe & Takashi (1988).

Birds and feed

A feeding trial was conducted in the poultry house at the University of Tadulako Palu, Indonesia. A total of 32 unsexed Cobb chickens was used as experimental animals. They were placed in the individually metabolism cages for two weeks. The birds were allowed to consume basal feed (Table 1) during the first week of adaptation period. After adaptation period, the birds were offered experimental diets (Table 2). Water was provided *ad-libitum* throughout the trial. The cages were routinely cleaned.

Table 1. Composition of the experimental control basal diet (%)

Ingredients	Grower diet
Full fat soybean meal	18.97
Corn	62.10
Fish meal	11.00
Rice bran	3.90
Palm oil	1.00
Dicalcium phosphate	1.20
Salt	0.20
Methionine	0.15
Lysine	0.11
Vitamine and mineral mixture	0.20
Calculated nutrient	
Crude protein	21.00
ME (kcal/kg)	3187.00
Crude fibre	3.60
Lysine	1.00
Methionine	0.40
Calcium	1.00
Phosphorous	0.70

Table 2. Experimental diets

Type of additive	<i>E. coli</i> challenge	Replications
Control	-	4
	+	4
Control + 0.05% palm kernel polysaccharides (PKP)	-	4
	+	4
Control + 0.05% copra polysaccharides (CP)	-	4
	+	4
Control + 2 ppm avilamycin	-	4
	+	4

Challenge protocol and parameters

After adaptation period, the birds were challenged against *E. coli* with the concentration of 1.5×10^8 CFU/ml on days 8, 10 and 12. This pathogenic bacteria was kindly provided by Health Laboratory, Undata Hospital, Palu Central Sulawesi. 5 ml of *E. coli* containing fluid was offered in drinking water. During a week of challenge period, feed intake and body weight were recorded. Total excreta from each broiler in the metabolism cages were collected for three consecutive days (days 13 to 15). The excreta was individually weighed after discarding any foreign materials, such as feather and spilled feed particles. The excreta was oven dried at 65°C for 24 hours (AOAC 1990).

Statistical analysis

This study used a randomized complete design with seven treatment diets and four replicate cages of one bird each metabolism cage. Data were analysed by analysis of variance and differences among treatments found in the analysis of variance were further tested for significance by Tukey Test (Steel & Torrie 1980).

RESULTS AND DISCUSSION

Results

The data on the effect of type of feed additives on bird performance, effect of *E. coli* challenge on bird performance and the effect of interaction between type of feed additives and *E. coli* challenge on bird performance were shown in Table 3, 4 and 5, respectively. The effects of type of feed additives on body weight gain, FCR and excreta dry matter was significantly affected. The effect of *E. coli* challenge significantly affected body weight gain and feed intake. There was an interaction between type of feed additives and *E. coli* challenge on bird performance.

Table 3. Effect of type of additive on body weight gain, feed intake, FCR and excreta dry matter

Treatments	Parameters			
	BWG (g)	Feed Intake (g)	FCR	Excreta DM (%)
Control	407 ^b	773 ^a	1.92 ^a	18.9 ^b
Control + PKP	472 ^a	810 ^a	1.72 ^b	23.7 ^a
Control + CP	473 ^a	814 ^a	1.72 ^b	24.5 ^a
Control + Avilamycin	474 ^a	800 ^a	1.70 ^b	24.8 ^a

Palm kernel polysaccharides (PKP); Control + copra polysaccharides (CP)

Values followed by different superscript significantly different at $P < 0.05$

Table 4. Effect of *E.coli* challenge on body weight gain, feed intake, FCR and excreta dry matter

Parameters	Treatments	
	<i>E. coli</i>	+ <i>E. coli</i>
Body weight gain (g)	476.00 ^a	436.00 ^b
Feed Intake (g)	824.00 ^a	774.00 ^b
Feed conversion ratio	1.73 ^a	1.80 ^a
Excreta dry matter (%)	24.20 ^a	21.70 ^a

Table 5. Effects of interaction between type of diet and bacteri challenge on body weight gain (BWG), feed intake (FI), FCR and excreta dry matter

Treatments		Variables			
Type of additive	<i>E. coli</i>	BWG (g)	FI (g)	FCR	Excreta DM (%)
Control	-	479 ^a	866 ^a	1.82 ^b	22.9 ^a
	+	334 ^b	679 ^b	2.03 ^a	14.9 ^b
Control + PKP	-	474 ^a	812 ^a	1.71 ^b	23.8 ^a
	+	469 ^a	807 ^a	1.72 ^b	23.7 ^a
Control + CP	-	474 ^a	813 ^a	1.71 ^b	24.9 ^a
	+	471 ^a	815 ^a	1.73 ^b	24.0 ^a
Control + Avilamycin	-	477 ^a	804 ^a	1.69 ^b	25.0 ^a
	+	470 ^a	797 ^a	1.70 ^b	24.5 ^a

Discussion

The use of prebiotic, either in the form of palm kernel polysaccharides or copra polysaccharides in broiler diets could increase body weight gain of broilers (Sundu et al. 2006; Sundu et al. 2009). These palm polysaccharides produced the same body weight gain as found in the birds fed antibiotic avilamycin. This indicates that the palm polysaccharides could replace avilamycin in the broiler diets. The improvement of body weight gain due to either palm polysaccharides and antibiotic supplementation might be partly due to the increase in the health status of the digestive tract of birds. Our current finding indicated that when the birds were challenged against pathogenic bacteria (*E. Coli*), body weight gain of birds decreased by 40 g. This preliminary study might bring hope for the controversy of the use of antibiotic in broiler diets.

Feed conversion ratio (FCR) was significantly improved when the diets were supplemented with either palm polysaccharides or antibiotic. Since there was no significant effect of the type feed additive on feed intake, it can be speculated here that the feed additives used in this current study may be effective in improving the quality of feed. However, the mechanism of improving feed quality is hard to rationalize. It is possibly through the increase in feed digestibility or feed absorption as a results of the increased health status of absorption site in the digestive tract. Feed intake of birds challenged against *E. coli* dropped from 824 g to 774 g. The decrease in feed intake is probably because of impaired digestibility and absorption. However, a study in the area of histology of the digestive tract and digestibility is needed to prove this speculation.

Wetter excreta was found in the birds fed the control diet. The supplementation of the control diet with palm carbohydrate or antibiotic avilamycin increased the dry matter of the excreta. Of eight experimental units in the birds fed control diet, 2 birds were suffering

from diarrhea and the birds were in the *E. coli* - challenged treatment. The problem of wet excreta is becoming more crucial as this could not only affect the health of the birds but also rise the environmental issue.

The interaction between type of additive and *E. coli* challenge was found in all parameters investigated. However, the pattern of interaction was relatively the same. The detrimental effect of the challenge of the birds against *E. coli* was only found when the birds fed the control diet. Supplementation of the control diet with palm polysaccharides or antibiotic could eliminate the negative effect of the pathogenic bacteria on body weight gain, feed intake, FCR and excreta dry matter. Since this is only a preliminary study with small number of birds used and few parameters investigated, it is too early to state that these two palm polysaccharides have the same efficacy as found in antibiotic avilamycin. A longer study with large number of birds and more parameters is needed to support this finding. However, this preliminary study produced a promising result.

CONCLUSION

Supplementation of the diet with palm polysaccharides or antibiotic avilamycin improved body weight gain, feed conversion ratio and dry matter of excreta. The interaction between type of feed additive and *E. coli* challenge was found in body weight gain, feed intake, feed conversion ratio and dry matter of excreta.

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