Supplementation of lauric acid and feed fiber to optimize the performance of broiler

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Abstract. The aim of this research was to optimize the role of lauric acid (LA) and feed fiber (FF) to increase the performance of the broiler. In total 360 unsex Lohmann MB 202-P broiler chicken were divided into 36 experimental unit in this research. A factorial experiment consist two factors based on completely randomized design was applied, the first factor was level of LA i.e. 1.30%; 1.95%; and 2.60%, while second factor was level of crude fiber (FF) i.e. 5%, 6%, 7%, and 8% in the diet. The level of LA was equivalent with coconut oil application in feed that is 3%. Each experimental unit was repeated three times, each treatment combination was applied to 30 birds. The observed variables were weight gain, cumulative feed intakes, feed conversion, and final body weight. Result showed that utilization of LA and FF significantly affected (P<0.01) to weight gain, cumulative feed intakes, and final body weight, but not on FCR (P>0.05). This study indicated that the using of 1.95% LA and 8% FF on the diet would have optimized cumulative feed intake, weight gain, feed conversion ratio and final body weight of broiler.

1. Introduction

The rapid growth rate is usually followed by increasing fat deposition, high metabolic disorders, mortality, and incidence of skeletal disorders as a result of the rapid progress in the development of genetic and improvement of nutrition in the broiler chickens. Prohibiting the use of antibiotic growth promoters (AGP) in feed results in low performance, feed conversion, and changes in the ecological microbes of the digestive tract which can cause become to be pathogenic. Some concerns about the use of AGP can cause potent resistance of some microorganisms, so alternative replacements are obtained from natural sources of feed ingredients that have the potential as antibacterial agents or a bioactive compound which can act as a prebiotic in the digestive tract of poultry.

Organic acids including medium-chain fatty acids (MCFA) can be used as alternative AGP that can improve broiler performance. One of which is classified as MCFA is lauric acid (LA). Lauric acid has twelve carbon atoms, beside as a source of energy, significantly against gram-positive bacteria, active against viruses that are coated with fat is as good as functions and protozoa. Compared with caprylic acid and myristic acid, monolaurin from more potential lauric acid, even trilaurin and dilaurine do not show this activity [1, 2]. The crude fiber in poultry feed has the benefit of helping intestinal peristaltic, preventing clumping of feed on the cecum, accelerating the rate of digesta and spurring the development of digestive organs, and also high crude fiber causing poultry to feel full, which can reduce consumption because crude fiber is voluminous. The energy level in the feed will determine the

amount of feed consumed, besides the energy factor in the feed, the tendency of crude fiber in feed can also affect the level of consumption. Broilers tend to increase their consumption if the metabolic energy content in the feed is low.

Some feeding strategies in broiler chickens are intended to increase feed intake, and the development of the digestive tract. The use of LA combined with fiber is expected to improve poultry performance. Therefore, the present study was carried out to assess the effect of combination of LA level and FF level in feed to optimizing broiler performance.

2. Materials and methods

2.1. Animal and experimental design.

A total of 360 unsex 1-d old broiler chicks (Lohman MB 202-P) were obtain from PT Japfa Comfeed Indonesia Tbk. Poultry Breeding Division Unit 13 Kauditan, Jl. Raya Manado-Bitung, Tumaluntung Village, North Minahasa District. They were kept in brooding cage in a room that equipped with temperature (23-33ºC) on a light/dark cycle until 7-d. Immediately after 7-d adjustment period, all birds were randomly assigned to twelve treatments combination. Each group had three replication cages with 30 birds were fed diet according to experimental design. The experiment was conducted in a completely randomized design with a 3x4 factorial arrangement with three replications. The first factor was three levels of lauric acid (LA), consisted of 3 levels i.e. A1=1.30, A2=1.95 and A3=2.60%, while the second factor was four levels of crude fiber (FF) i.e. B1=5%, B2=6%, B3=7%, and B4=8% in the diet. The level of LA was equivalent with application coconut oil in feed that was 3%, based on LA content. LA used on this study was pure LA (99.5%) (commercial name Sinar FA 1299 produced by Sinar Mas). The composition of rations and the content of feed substances are presented in Table 1. The ration was arranged at an energy level of 3100-3200 kcal kg^{-1} with a crude protein of 20%. Each treatment was given diet from 14 to 35 day of age during the experimental period. Ration and drinking water were provided *ad libitum*. Effect of treatment on weight gain, cumulative feed intake was determined at 21-d and 35-d of age. The feed intake and body weight (BW) were monitored on days 21, 28, and 35 days to determine growth performance and feed conversion ratio (FCR).

Table 1: Ingredient composition and nutrient content of diets as fed basis

Items	A1B1	A1B2	A1B3	A1B4	A2B1	A2B2	A2B3	A2B4	A3B1	A3B2	A3B3	A3B4
Ingredients (%)												
Yellow Corn	31.7	22.7	20.7	8.70	26.05	27.05	20.05	8.05	29.4	23.4	19.4	11.4
SBM	22.0	20.0	23.0	7.0	16.0	19.0	23.0	7.0	21.0	20.0	23.0	7.0
Fish meal	5.0	5.0	6.0	9.0	6.0	6.0	6.0	9.0	5.0	5.0	6.0	8.0
Rice bran	14.0	20.0	28.0	28.0	11.0	21.0	28.0	29.0	14.0	20.0	28.0	29.0
MBM	5.0	4.5	4.0	7.0	5.0	4.0	7.0	6.0	5.0	4.5	4.0	7.0
BR-21F	20.0	25.5	16.0	38.0	19.0	16.0	37.0	32.0	22.0	23.5	16.0	34.0
	1.30	1.30	1.30	1.30	1.95	1.95	1.95	1.95	2.60	2.60	2.60	2.60
NaCl	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
DL-methionine (99%)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Premix[1]	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Total	100	100	100	100	100	100	100	100	100	100	100	100
Nutrient content												
ME (Kcal/kg)	3125	3157	3159	3125	3287	3169	3148	3205	3207	3200	3171	3219
CP (%)	20.4	20.3	20.1	20.5	20.5	19.9	20.3	20.3	20.2	19.9	20.4	19.5
EE (%)	5.8	5.9	5.9	6.0	6.7	6.6	6.5	8.0	7.1	7.2	7.2	8.0
CF (%)	5.1	6.3	7.2	8.1	5.1	6.2	7.2	8.2	5.1	6.2	7.2	8.1

SBM, soy bean meal; MBM, meat bone meal; BR-21F, commercial feed; NaCl, natrium chloride; ME, metabolizable energy; CP, crude protein; EE, extract ether; CF, crude fiber; [1]Premix supplied the following per ton of diet: Iron, 40 mg; Copper, 2[illegible]6 mg; Zinc, 40 mg; Manganese, 44 mg; Selenium, 0.08 mg; Cobalt, 0.08 mg; Iodine, 0.52 mg; Vit A, 12500 IU; Vit D3, 35000 IU; Vit E, 25 IU; Vit K3, 4 mg; Vit B1, 4 mg; Vit B2, 8

mg; Vit B6, 20 mg; Vit B12, 50 mcg; Pantothenic acid, 15 mg; Niacin, 50 mg; Biotin, 125 mcg; Calcium D-pantothenate, 16.30 mg; Folic acid, 1 mg.

2.2. Parameter measured

The weight of feed offered and unconsumed ration was recorded to determine the feed intake (FI). Body weight gain (BWG) was calculated by difference between two consecutive weighing. Before weighing the experimental chicken were fasted first for 8 h. FCR was calculated as the ratio of FI to WG.

2.3. Statistics analysis

The whole data analysis was done by general linear model on Minitab (version 19). Differences between treatments means were tested by Tukey simultaneous test (HSD). Significance was evaluated at the level of $P<0.01$ and $P<0.05$.

3. Results and discussion

The average value of experimental chicken performance during the study is presented in Table 2. The statistical test results showed that both LA and FF levels had a highly significant effect ($P<0.01$) on BWG, but there was no interaction between the two. The statistical results showed that increased levels of LA to 2.6% and increased levels of FF to 8%, greatly affect the BWG. The LA at level 1.95% produces BWG 5.28% higher ($P<0.05$) compared to LA at 1.3% and 6.225 higher than LA at level 2.6%. Increasing level FF up to 8% in feed produced BWGs of 9.14%, 9.91%, and 8.77% higher compared to the other three levels. Body weight is a consequence of feed consumption, so feed consumption is the main variable to measure feed efficiency. The amount of feed consumed is influenced by the digestibility of food substances in it.

Table 2. Effect of lauric acid and crude fiber in ration on performance of broiler

	Level of LA (%)	Level of crude fiber in ration (%)				Average
		5	6	7	8	
Weight gain (g)	1.30	1002.56 ±53.97	1036.67±78.89	982.86 ±68.82	1166.42 ±27.29	1047.13 ±82.58^{AB}
	1.95	1140.50 ±49.59	1069.75 ±68.43	1062.78 ±44.21	1148.92 ±52.92	1105.49 ±45.51^{A}
	2.60	971.42 ±73.85	981.54 ±83.95	1081.67 ±22.10	1112.47 ±34.74	1036.77 ±70.87^{B}
	Average	1038.16±89.99^{B}	1029.32±44.56^{B}	1042.44±52.45^{B}	1142.60±27.52^{A}	
Feed intake (g)	1.30	1873.50±35.96^{CD}	1869.92±37.72^{CD}	1959.97±61.40^{BC}	2113.58 ±24.66^{A}	1954.24 ±114.09
	1.95	2028.92±16.54^{CD}	1987.00±21.36^{BC}	2015.25±55.44^{AB}	1999.42±28.49^{AB}	2007.65 ±78.30
	2.60	1814.75 ±21.52^{D}	1892.94±40.85^{CD}	1962.25±70.09^{BC}	2073.11±56.28^{AB}	1935.76 ±109.61
	Average	1905.72 ±110.66	1916.62 ±62.03	1979.16 ±31.28	2062.04 ±57.88	
Feed conversion ratio	1.30	1.87 ±0.08	1.81 ±0.10	2.00 ±0.08	1.81±0.06	1.87 ±0.09
	1.95	1.78 ±0.08	1.86 ±0.13	1.90 ±0.12	1.74 ±0.06	1.82 ±0.07
	2.60	1.87 ±0.13	1.90 ±0.12	1.81 ±0.05	1.86 ±0.04	1.86 ±0.04
	Average	1.84 ±0.05	1.86 ±0.05	1.90 ±0.09	1.81 ±0.06	
Final body weight (g)	1.30	1660.97±53.97^{ABC}	1707.67±53.97^{ABC}	1661.53±53.97^{ABC}	1828.33 ±53.97^{A}	1714.63±78.90
	1.95	1829.92 ±21.29^{A}	1731.33±63.20^{ABC}	1742.11±60.02^{ABC}	1818.33±85.62^{AB}	1780.42 ±50.87
	2.60	1637.67 ±36.37^{C}	1653.07 ±86.85^{BC}	1786.08±57.33^{ABC}	1800.64±36.77^{ABC}	1719.36 ±85.88
	Average	1709.52 ±104.92	1697.36 ±40.14	1729.91 ±63.17	1815.77 ±14.02	

In the variable cumulative FI and FBW of experimental chicken as well as, there was an interaction between LA level and FF. As the level of LA and FF showed a significant interaction, the LA dependent on FF and *vice versa*. The combination of treatments has no significant effect on FCR. The FCR results of this study were slightly higher than those stated by [3, 4]. The feed conversion in this study was not affected either by LA or by FF. In the 1960s, the FCR was still 2.2. Along with genetic improvement over time so that the current FCR for broilers was 1.75 [4]. The decrease in FCR value occurs because more feed is directed for growth and very little for maintenance until it was marketed. FCR for Lohman broilers at 5 weeks of age consecutive were 1.66 [3], and 1.74 [5] used a combination of 1.3% LA with *Areca vestiaria* Giseke at level 625 mg/kg in ration.

In healthy animals, the composition of the intestinal microflora remains stable, but if the stability is damaged, pathogenic microorganisms are able to control the intestine which causes serious infections [6]. Lauric acid as a feed additive improve a food security of broiler meat because of its capability to suppress the development of pathogenic bacteria in gut [7]. *Campyllobacter*, *Escherichia coli*, and *Salmonella* in chickens are pathogenic microorganisms especially in the digestive tract. This infection does not cause serious illness in chickens, but chickens infected with Salmonella are a source of pathogens in humans. Campylobacteriosis is one of the causes diarrhea in human [8]. Lauric acid in broiler meat reduced *Camphylobacter* from 5.9 log cfu g^{-1} to 3.5 log cfu g^{-1} compared control (4.3 log cfu g^{-1}).

As reported before, the administration of 1.3% LA combined with the natural antioxidant from *Areca vestiaria* Giseke at a dose of 1250 mg per kg of feed was able to reduce total intestinal bacteria from 5,255 log cfu per gram to 5,155 log cfu per gram [9]. Component fiber in feed is distinguished between soluble dietary and insoluble dietary fiber. Combination of LA and FF in this research improve gut health which in turn increasing FI and BW.

4. Conclusion

The conclusion of this study indicated that the used of 1.95% LA and 8% FF level on the diet would have an optimize cumulative feed intake, weight gain, feed conversion ratio and final body weight of broiler.

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