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SERUM LIPID PROFILE OF BROILER CONSUMING RATION CONTAINING LAURIC ACID AND FEED FIBER

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Abstract

The aim of this experiment was to evaluate effect of level lauric acid (LA) combined with feed fiber (FF) in ration on serum lipid profile of broiler. A total of 360 unsex 1-d old broiler chicks were obtain from broiler breeding company. They were kept in brooding cage with temperature 23-33°C on a light/dark cycle until 7-d. After 7-d adjustment period, all bird randomly assigned to 12 treatments combination. Each group having three replicate cages with 30 birds was fed diet according experimental design. The experiment was conducted in a completely randomized design with a 3 x 4 factorial arrangement. The first factor was level of LA consisted of 3 levels i.e. 1.30%; 1.95%; and 2.60%, while the second was level of FF i.e. 5%, 6%, 7%, and 8% in the diet. Each treatment was given diet from 21 to 35 day of age during the experimental period. Effect of treatment on serum lipid consists of total cholesterol, triglyceride, HDL-cholesterol, and LDL-cholesterol was determined at the end of experiment (35-d of age). The conclusion of this study indicated that the used of 1.95% LA and 8% FF level on the diet would have an optimize serum lipid profile of broiler.

***Key words**: feed fiber, lauric acid, serum lipid profile.*

INTRODUCTION

Functional food is defined as a compound that contains physiologically active compounds (bioactive compounds) and is used for the prevention or cure of a disease or for achieving optimal body health. Increasing the economic status of the community, causing consumption of animal products to increase as well. The essential components in the community's diet are meat and processed meat products (Fernandez-Gines et al., 2005).

According to WHO in 2010, 25% of deaths in developing countries were due to cardiovascular disease. Cardiovascular disease and type-2 diabetes are considered as a result of increased consumption of animal products. Much research has been done to dismiss this assumption.

The results showed that total fat, saturated fatty acids and monounsaturated fatty acids were not associated with deaths from coronary heart disease, and consumption of saturated fatty acids was not related to the risk of coronary heart disease, stroke and cardiovascular disease.

Pure lauric acid (LA) can be used in feed with the same function as coconut oil as an energy source as well as a source of saturated fatty acids. Medium chain fatty acids (MCFA) in LA contain 95.5% lauric acid (Londok et al., 2018). The superiority of MCFA over long chain fatty acids (LCFA) is its metabolic processes in the body. MCFA has a smaller molecular weight so it does not require high energy and only requires a little enzyme to break down the fat into a form that is ready to be absorbed (Gheorghe et al., 2019; Papamandjaris et al., 1998; DebMandal and Mandal, 2015). Crude fiber is one of the important food substances in poultry rations, because it functions to stimulate the digestive tract peristalsis so that the digestion process of feed substances goes well. Poultry has limitations in digesting coarse fibers because the fermenter organ is located at the end of the absorptive organ. High crude fiber causes poultry to feel full, which can reduce consumption because crude fiber is voluminous. The level of energy in the feed will determine the amount of feed consumed. Broilers tend to increase their consumption if the metabolic energy content in feed is low.

Feed formulation by optimizing the use of fiber-rich feed ingredients can reduce meat fat content so that it becomes a safe/healthy meat product for consumers.

Strengthening the supply of food from animal experiences is a dilemma because on one hand meat consumption per capita is still low but on the other hand there is a tendency for certain consumers to limit consumption of livestock meat because of the negative effect of food on health. This issue is certainly a challenge for animal husbandry experts on how to develop businesses that can produce livestock commodities with carcasses that have high edible meat portions as a source of food that is safe and healthy for consumers. Food security which aims to increase the availability of food based on food security and independence, improving the quality of consumption and improving the quality and food safety.

MATERIALS AND METHODS

This study was conducted on 360 day-old unsexed Lohman broilers (MB 202-P) with an average body weight of 45.76 ± 1.73 grams, obtained from the breeding of PT Japfa Comfeed Indonesia Tbk chickens. Poultry Breeding Division Unit 13 Kauditan, Jl. Raya Manado-Bitung, Tumaluntung Village, North Minahasa Regency.

The chicken was placed in a brooder cage at a temperature of 23-33ºC for 7 days. After the random adjustment period the chickens were placed in 12 treatment plots which were repeated 3 times. The study was designed using a completely randomized 3x4 factorial design. As factor A is the level of lauric acid (LA), which is A1 = 1.30%, A2 = 1.95%, and A3 = 2.60%. Factor B is the level of feed fiber (FF), namely B1 = 5%, B2 = 6%, B3 = 7%, and B4 = 8%. Determination of LA level based on the application of coconut oil in feed by 3% which is calculated lauric acid content.

There are 12 treatment combinations. LA used in this study was pure LA (99.5%) FA 1299 rays produced by Sinar Mas. The composition of the feed and its ingredients are presented in Table 1.

Table 1. Composition and ingredient of treatment feed (*as fed*)

Items	A1 B1	A1 B2	A1 B3	A1 B4	A2 B1	A2 B2	A2 B3	A2 B4	A3 B1	A3 B2	A3 B3	A3 B4
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
LA	**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, 26.16 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.

The treatment ration was made at a metabolic energy level between 3100-3200 kcal kg^{-1} with a crude protein level of 20%. The treatment feed and drinking water were applied ad libitum on days 21 to 35 days to the experimental chicken, so that each treatment combination was applied to 30 chickens. An interactions were shown by variables of total cholesterol, triglycerides, HDL-cholesterol, and LDL-cholesterol.

Measurement of serum fat is done through laboratory analysis of total cholesterol, triglycerides, HDL-cholesterol, and LDL-cholesterol. Blood sampling for parameter determination was performed at the end of the study (day 35), in chickens that were fasted for ± 8 hours.

Overall data were analysed using the general linear model in Minitab (version 19). The difference in the mean value of the treatment was tested by Tukey simultaneous test. The difference was evaluated at the P level, 0.05.

RESULTS AND DISCUSSIONS

The average of total cholesterol, triglycerides (TG), HDL-cholesterol, LDL-cholesterol and the ratio of HDL to LDL in chicken serum results of this study were presented in Table 2. Total cholesterol, TG, HDL-cholesterol, LDL-cholesterol and HDL to serum LDL ratio were statistically significant influenced by the level of lauric acid, the level of feed fiber and the interaction of both. The different effect of blood lipids was thought to be caused by differences in fatty acids in the feed, because the transport of MCFA (lauric acid) is not in the form of lipoproteins. In the body, cholesterol is transported through the bloodstream by a type of fat called lipoprotein. There were several types of lipoproteins that were known, namely: very low density lipoprotein (VLDL) and LDL. These types of lipoproteins all contain a lot of TG and cholesterol. VLDL had more TG (60%), whereas LDL and HDL had more cholesterol (44%) (Piliang and Djojosoebagio, 2006). VLDL-cholesterol is usually released into the bloodstream continuously by the liver. This condition ensures a steady supply of TG to other cells of the body as a source of energy for metabolic processes. This increases lipoproteins that are rich in cholesterol particles, in the form of LDL. MCFA does not reduce cholesterol through the transport of LDL cholesterol to the liver but by other mechanisms. Apolipoprotein B (Apo-B) is the main apolipoprotein from chylomicrons and LDL-cholesterol which is responsible for bringing cholesterol to the tissues. Apo-B in MCFA is lower than LCFA (Wang et al. 2015).

The interaction between levelof LA and the level of crude fiber ($P < 0.05$) influences total cholesterol levels, TG, HDL-cholesterol, LDL-cholesterol and the ratio of HDL to LDL serum. The highest total serum cholesterol level was shown by the chicken consumming 1.95% LA and 6% FF (109.67 ± 0.28 $mg.dL^{-1}$), while the lowest concentration was shown by the fed chicken supplemented with 2.6% LA with 7% FF (103.59 ± 0.28 $mg.dL^{-1}$). Saturated fats decrease LDL receptor (LDLr) activity and increase LDL production (Merchant et al., 2008). LDLr is the key to regulating cholesterol homeostasis feedback (Musa et al*.,* 2007). The absorption of LDL cholesterol from peripheral tissues is mediated by LDLr. LDLr is negatively correlated with serum LDL and abdominal fat percentage (Murwani et al., 2011). When LDLr is high, the serum LDL and abdominal fat are low. Research on adding palm oil and coconut oil to broiler feed was carried out by Piliang et al. (1995). It was reported that a decrease in total cholesterol, HDL and serum LDL. Dong et al. (2003), using coconut oil as a source of MCFA in pregnant mice. The use of coconut oil decreases TG, increasing serum HDL-cholesterol at the age of 3 weeks. Fatimah and Rindengan (2011) found the same thing using pure coconut oil in rat feed. Londok et al. (2014) supplemented virgin coconut oil as a source of lauric acid up to 3% in high fiber-based feed in broiler feed, it was able to increase serum HDL, reduce serum LDL and reduce meat cholesterol. Furthermore Londok (2018) supplemented 3% coconut oil with natural antioxidant Areca vestiaria Giseke at a dose of 1250 $mg.kg^{-1}$ showing a marked increase in HDL and a decrease in LDL. Wang et al. (2015) uses coconut oil and soybean oil as a source of MCFA in broiler feed. Linearly, total cholesterol and LDL decreased, but TG increased while HDL did not differ significantly.

Table 2. Average of lipid profile in broiler serum consumed different level of LA and FF (mg dL^{-1})

Parameters	LA Level (%)	FF Level (%)				Average
		5	6	7	8	
Total cholesterol (mg dL^{-1})	1.30	103.91 ± 1.07^{AB}	109.67 ± 0.28^{A}	103.59 ± 0.28^{AB}	101.01 ± 1.16^{BC}	104.54 ± 3.65
	1.95	$94.75\pm1.93C^{DE}$	104.96 ± 3.89^{AB}	107.46 ± 3.04^{AB}	103.26 ± 2.27^{AB}	102.61 ± 5.51
	2.60	95.58 ± 2.76^{CD}	91.44 ± 2.49^{DE}	88.12 ± 1.93^{E}	89.08 ± 4.29^{DE}	91.05 ± 3.32
	Average	98.08 ± 5.06	102.02 ± 9.46	99.72 ± 10.23	97.78 ± 7.62	
Triglycerides (mg dL^{-1})	1.30	47.64 ± 2.37^{ABC}	45.87 ± 2.03^{ABCD}	47.04 ± 3.19^{ABC}	46.87 ± 2.37^{ABC}	46.85 ± 0.78.
	1.95	41.59 ± 2.25^{BCD}	36.59 ± 4.28^{D}	43.68 ± 2.14^{ABCD}	40.77 ± 2.31^{BCD}	40.66 ± 2.98
	2.60	48.85 ± 4.23^{AB}	40.39 ± 5.00^{BCD}	38.85 ± 5.00^{CD}	52.23 ± 1.47^{A}	45.08 ± 6.49
	Average	46.03 ± 3.89	40.95 ± 4.67	43.19 ± 4.12	46.62 ± 5.74	
HDL-cholesterol (mg dL^{-1})	1.30	52.28 ± 1.11^{DE}	55.74 ± 1.61^{DE}	59.28 ± 2.43^{BCD}	49.31 ± 3.58^{E}	54.15 ± 4.31
	1.95	66.63 ± 2.82^{AB}	67.79 ± 3.15^{AB}	68.22 ± 5.44^{AB}	56.60 ± 3.96^{CDE}	64.81 ± 5.51
	2.60	70.45 ± 1.48^{A}	65.87 ± 2.60^{ABC}	60.19 ± 3.83^{BCD}	56.92 ± 3.15^{CDE}	63.36 ± 6.00
	Average	63.12 ± 9.58	63.13 ± 6.48	62.56 ± 4.92	54.28 ± 4.30	
LDL-cholesterol (mg dL^{-1})	1.30	42.10 ± 1.71^{A}	44.76 ± 1.74^{A}	34.91 ± 3.34^{BC}	42.33 ± 2.93^{A}	41.02 ± 4.25
	1.95	19.80 ± 1.34^{D}	29.85 ± 0.12^{C}	30.50 ± 1.97^{C}	38.50 ± 2.15^{AB}	29.66 ± 7.66
	2.60	15.36 ± 0.43^{D}	20.36 ± 3.05^{D}	20.16 ± 4.76^{D}	21.72 ± 0.85^{D}	19.40 ± 2.78
	Average	25.76 ± 14.33	31.65 ± 12.30	28.52 ± 7.57	34.18 ± 10.96	
HDL: LDL ratio	1.30	1.24 ± 0.08^{D}	1.25 ± 0.08^{D}	1.72 ± 0.23^{CD}	1.17 ± 0.17^{D}	1.35 ± 0.25
	1.95	3.39 ± 0.37^{B}	2.27 ± 0.11^{BCD}	2.26 ± 0.32^{BCD}	1.85 ± 0.66^{CD}	2.44 ± 0.66
	2.60	4.59 ± 0.03^{A}	3.05 ± 0.37^{B}	3.21 ± 0.95^{B}	2.62 ± 0.04^{BC}	3.37 ± 0.85
	Average	3.07 ± 1.69	2.19 ± 0.90	2.40 ± 0.75	1.88 ± 0.72	

The average ratio of HDL to LDL in serum of experimental chickens that consume feed supplemented with different lauric sources and antioxidant concentrations provides a very significant interaction ($P<0.01$) in influencing serum HDL: LDL ratio. The highest average serum HDL: LDL ratio was shown by chicken fed a combination of feed containing 2.6% LA with 5% dietary fiber (4.59 ± 0.03 mg.dL^{-1}), while the lowest HDL: LDL ratio was shown by a combination of 1.3% LA with 8 % FF (1.17 ± 0.17 mg.dL^{-1}). Coronary atherosclerosis is associated with a high plasma cholesterol-HDL: LDL ratio (Mayes et al. 1995). Each 5% increase in energy consumption from saturated fat is proportional to the energy consumption from carbohydrate and causes a 17% increase in the risk of heart disease (Hu et al. 1997). However Kolondam et al. (2008), concluded that administration of virgin coconut oil (VCO) with therapeutic doses (0.95 mL) and two doses in wistar rats (*Rattus norvegicus*) had no effect on blood lipid levels after being consumed for 30 days, increasing the level of VCO did not cause changes in blood lipid levels during the study. Other results also showed that changes in blood lipid levels after administration of virgin coconut oil did not result in changes in the risk of heart disease in test animals, and claims about the dangers of saturated fat consumption in VCO against increased blood lipids were not proven.

CONCLUSIONS

The use of lauric acid 1.95% with 8% feed fiber level provides optimal broiler serum lipid profile.

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