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Effect of bile acid supplementation in broiler feed on performance, carcass, cholesterol, triglycerides and blood glucose

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Abstract. This study aims to evaluate the effect of the addition of bile acid to optimize the use of energy from oil in poultry feed. Two hundreds broiler 1-day old Cobb were randomly assigned to 4 treatments with 5 replicate of 10 chicks each for 35 d. The experimental treatments received a corn-soybean basal diet containing 1.5 % CPO (crude palm oil) and were as follows: 0 (control), 0.5 g, 1 g, and 1.5 g bile acids/kg of diet. Dietary of inclusion bile acids significantly tended to decrease feed intake from d 21 to d 28 ($P < 0.079$). However, average daily, feed intake and FCR was unaffected by dietary supplementation with bile acids in 14 d to 21 d and d 28 to d 35. The dressing percentage, abdominal fat, liver, gizzard, non significant difference ($P > 0.05$) for broilers fed diets supplemented with bile acids. In 35-day-old broilers, serum triglycerides (TG), glucose and total cholesterol were unaffected ($P > 0.05$) by bile acids supplementation. The results gives a update information that supplementation of bile acid in diets could potentially for future improvement in broilers performance.

1. Introduction

The energy component is the biggest cost in poultry feed, which is 55-60% of the total feed cost. Corn is often used as the main energy source in commercial chicken feed. However, the availability of corn in the field is very limited due to fluctuating production cause by unfavorable seasons. This will have an impact on reducing the quality of carbohydrates which results in lowering energy content. To overcome this problem, oil and fat used as additional ingredients in feed

Fats and oils are the main energy source of animals and have the highest caloric value of all nutrient, with metabolic energy (AME) almost 3 times higher than other feed ingredients as energy sources such as corn. Along with that continuous genetic improvement continuously, the nutritional requirements of modern poultry breeds have increased, especially the need for high energy intake, which requires the provision of high-energy feed. Therefore, fat is added to the poultry diet to meet energy needs, but has constraints are that fat is difficult to digest because of the nature of fat that is difficult to dissolve in water.

Digestion and absorption of fat is less developed in young animals due to limited bile endogenous secretion. Bile acid is a natural ingredient that can be obtained from chickens or cattle slaughter waste which has the ability to emulsify fat [1]. Bile acid are synthesized from cholesterol in the liver. Bile acid in avian consist of and cholic acid and chenodeoxycholic acid [2]. Bile acid have 24 carbon atoms

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and are abbreviated as C₂₄ bile acids [3], and under physiological these conjugation increases their water solubility [4]. The lack of information with the right dosage of the use of this material has resulted in the use of this material not much developed. The use of bile acid will increase the digestibility of fat in feed so that it will contribute to improving the performance of commercial chicken production [5].

Our hypothesis is that bile acids may have an additive effect with endogenous bile in improving digestion of broilers when fed with high content of CPO (crude palm oil) as source a dietary fat. However extent of exogenous bile acids supplementation in feed and its effect on fat absorption is scarce information. Therefore, the objective of this study was to reexamine the effects of exogenous bile acids on broiler performance, carcass traits, blood metabolites parameters when crude oil was used as supplement of energy source in broiler diet.

2. Materials and Methods

2.1. Preparation bile acids

Bile acids used in this experimental were provided by local feed supplement producer (Traville Indonesia). These were extracted from chicken bile paste by a process that includes extraction, purification and dryer. The bile acids were composed with filler by 20:80.

2.2. Animal and diets

A total of 200 1-day-old Cobb broiler chicks (42.01 ± 0.26 g) were obtained from local commercial distributor. On d 1, all birds were randomly assigned to 4 treatments, with 10 per pen and 5 replicate pens per treatment. The diets consisted of a corn and soybean diet with 0, 0.5, 1, or 1.5 g bile acid/kg feed, respectively. Crude palm oil was added to the feed as a fat source. From d 1 to d 21, the broilers were fed the starter diets and fed the grower diets from d 21 to d 35. All diets were prepared in pellet feed form. All nutrients contained in the basal diet met or exceeded the requirements suggested by the NRC 1994 [6]. The ingredients and chemical composition of the basal diet are shown in **Tables 1**.

2.3. Collection of Performance Data

The body weight and feed consumption of the broilers were recorded in each pen on d 14 and d 35 and these values were used to calculate the average daily gain (ADG), average daily feed intake (ADFI), and feed conversion ratio of the broilers (F:G) for the periods between d 14 -d 21, d 22-d 28, d 28- d 35 and cumulative d 14- d 35.

On d 35 broiler chickens were electrical stunned, scalded, defeathered, eviscerated and weighed and then placed in cooling room. Whole carcass were weighed. Carcass percentage were determined from individual BW. The liver, heart, proventriculus, gizzard (removal of content), abdominal fat, lungs, and kidneys were determined from individual carcass weighed of broiler sampled.

2.4. Blood samples

On d 35, the blood sampled were collected one hour after morning feeding in one chickens from each pen as soon as possible from the wing vein (five birds/treatment) using a 1 mL syringe. One mL was carefully transferred into heparinized tube (BD Vacutainer). The blood was for determination of glucose, cholesterol and triglycerides. All samples were then centrifuged at 2,000 rpm for 10 min in a refrigerated centrifuge. Blood plasma glucose was determined by Hexokinase-mediated reaction method [7] as the instruction in kit's manufacture (Roche/Hitachi Cobas C Chemistry Analyzer manual book). Blood plasma triglyceride content (TG) were determined uses colorimetric enzymatic, total cholesterol were determined by reagent CHOD PAP and the spectrophotometric method, using COBAS 311 analyzer (Roche diagnostic Indianapolis, USA).

2.5. Statistical Analysis

Data were analysis using completely randomized design with ANOVA. The Minitab software package was used for statically analysis (Minitab Inc, USA). The statistic models With the following models $Y_{ij} = \mu + \alpha_i + \epsilon_{ij}$. Where Y=dependent variables, μ : overall mean, α_i : the effect of treatment, ϵ_{ij} : random error. The post hoc Duncan New Multiple Range Test test was calculated and significant level was test at (P<0.05).

Table 1. Analyzed composition of experimental diets

Item	Starter phase	Finisher phase
Ingredients (%)		
Yellow corn	53.50	58.00
Commercial concentrate for broiler	34.00	30.00
Rice meal	9.94	9.44
CPO Oil	1.50	1.50
Premix minerals)*	1.00	1.00
DL Methionine	0.05	0.05
L Lysin	0.01	0.01
Composition analysis		
Crude Protein (%)	21.0	19.0
Crude Fat (%)	5.0	5.0
Crude Fiber (%)	3.0	3.0
Ca (%)	1.5	1.5
P (%)	0.7	0.7
ME (Kcal/Kg)	2800	3.200

*) Per kilogram premixa minerals contains : vitamin A, 8.900 IU; vitamin D 3.200 IU
 vitamin K 18 mg, Vitamin E 22 mg; vitamin K3, 17 mg; , riboflavin, 5.0 mg,
 cobalamin 0.1 mg; choline chloride ,500 mg, Fe77 mg, CuSO4

3. Results and Discussion

The results of the analysis (Table 2) show that the supplementation of bile acid with different doses did not show any significant difference (P> 0.05) on the consumption of broiler feed at weeks 3, 5 and cumulative weeks 3-5. Whereas at week 4 it was seen that control treatment were tended to be higher compared to feed with the addition of bile acid (P <0.08). The difference in feed consumption is likely due to the effect of bile acid action. The supplementation of bile acid can increase the absorption of fat which can produce higher energy, so that the chicken consumes less feed than the control feed. This is in line with the stated [8] that the bile acid supplementation in broiler chicken feed can increase fat brightness and increase lipase activity in the intestinal tract, which may fulfill the energy balance [9-11]. However, the addition of bile acid did not show significant differences in body weight gain and feed conversion in broilers in all treatment groups and at all time points as shown in Table 2.

In this study the composition of feed between treatments had the same composition so it did not cause differences differences in body weight gain. Other researchers suggest that exogenous bile acid will usually have an effect on growth, especially in young chickens, where bile acid production is not balanced with the process of fat metabolism. In this study showed a numerical tendency to decrease the conversion between control feed and bile acid supplemented feed 1 g / kg by 0.05 at all time

points. This numerical decrease shows the unclear results of the effect of adding bile acid to the feed. According to [8] lipase activity in the intestine is also very influential on fat metabolism which may affect fat absorption.

Table 2. Effect of dietary bile acids on performance of broilers

Item	Content of bile acids (g/kg feed)				SEM	P value
	0	0.5	1	1.5		
14-21 d						
• ADFI (g)	761,14	746,66	742,98	744,52	14,78	0,231
• ADG (g)	534,40	532,40	538,80	524,00	20,80	0,724
• F : G	1,43	1,40	1,38	1,42	0,04	0,419
21-28 d						
• ADFI (g)	1.004,74	965,76	969,50	965,42	25,82	0,079
• ADG (g)	506,23	500,10	499,60	489,24	36,99	0,908
• F : G	2,00	1,93	1,94	1,99	0,15	0,879
28-35 d						
• ADFI (g)	1.150,53	1.124,79	1.138,30	1.163,70	59,06	0,758
• ADG (g)	550,38	531,16	574,71	578,46	64,54	0,634
• F : G	2,14	2,12	1,99	2,02	0,21	0,627
14-35 d						
• ADFI (g)	2.916,41	2.837,21	2.850,78	2.873,64	88,16	0,527
• ADG (g)	1.591,01	1.563,66	1.586,11	1.591,70	72,31	0,763
• F : G	1,84	1,82	1,80	1,81	0,05	0,323

SEM : Standart error mean

ADG = Average daily gain; ADFI = Average daily feed intake; F:G = feed conversion ratio, which is defined as feed to gain ratio.

Table 3. Effect of dietary bile acids on slaughter performance of broilers at the age of d 35

Item	Content of bile acids (g/kg feed)				SEM	P value
	0	0.5	1	1.5		
Carcass (%)	68,66	67,75	69,57	68,97	2,25	0,642
Liver (%)	1,99	2,19	2,10	2,03	0,27	0,685
Abdominal fat (%)	2,48	2,22	1,97	2,31	0,44	0,360
Ventriculus (%)	1,97	1,97	2,08	1,86	0,23	0,550
Heart (%)	0,46	0,43	0,49	0,46	0,06	0,623
Eviscerated weight (%)	11,81	11,80	11,98	12,13	1,20	0,966

SEM : Standart error mean

The effect of the addition of bile acid to the concentration of blood metabolites is shown in Table 4. In the picture the glucose, cholesterol and TG concentrations in the blood plasma are higher compared to control feeds especially in addition to the dose of 1 g / kg of feed. Glucose content in bile acid supplementation at the dose 1 g/kg is 237 mg / dL higher than control feed was 224 mg / dL as well as cholesterol and TG with the addition of bile acid 1 g/kg higher than control treatment, 151 versus 122 and 162 versus 140 mg / dL, respectively. From this data as a fact that shows the addition of bile acid

has the potential to increase the fat absorption which may affects the cholesterol and TG concentration in blood plasma. Cholesterol and TG content in plasma are influenced by fat metabolism as well as carbohydrate and protein. Cholesterol content is influenced by the amount of fat absorption in the digestive tract, increasing absorption causes an increase in cholesterol content in the blood which is affected by the lipolysis process [12]. TG analysis, blood cholesterol is a key indicator in fat metabolism [13].

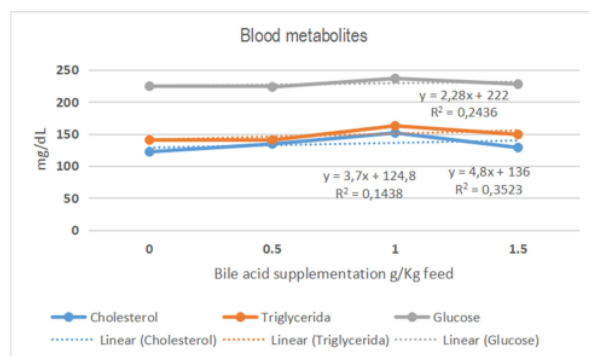


Figure 1 . Effect of bile acids on blood plasma biochemical indices (mg/dL) of broilers 35 d

An increase in the supplementation of bile acid will increase the content of triglycerides and cholesterol, this is because bile acid can increase the emulsion of fat so that it is more easily absorbed through cell membranes, this micelle formation will have a positive effect to penetrate the unstirred water layer which often becomes a barrier in the fat absorption, so this micelle form will make the formation of polar groups that are hydrophilic so that it can penetrate the water layer, by increasing the absorption will increase the energy that affects the feed intake and feed conversion ratio.

4. Conclusion

The results demonstrated that supplementation of bile acid in diets could potentially for future improvement in broilers performance.

5. Acknowledgments

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