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EFFECT OF COMBINATION CHITOSAN AND TURMERIC POWDER (*Curcuma domestica* Val.) FOR IMPROVING BLOOD LIPID PROFILE IN BROILERS

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Abstract

Chicken's meat is commonly eaten by most of the world's population. Besides, it has a good source of dietary protein and can provide high biological value, the meat also has a source of fat including saturated fatty acids (SFA), unsaturated fatty acids (USFA), cholesterol, triacylglycerol and phospholipids. But lipids categories can be the risk factors or the initiator of metabolic disease. The study aimed to know a potential and the best level of combination chitosan and turmeric powder for improving composition of blood lipid profile such as cholesterol and triacylglycerol, so it can increasing meat quality. The experimental was held for 30 days and the blood samples was investigated in the last days. The experimental design was used completely randomized design with 5 treatment (R1 = Chitosan 0% + Turmeric Powder 0%; R2 = C 1% + T.P 1%; R3 = C 2% + T.P 1%; R4 = C 1% + T.P 2%; R2 = C 2% + T.P 2%) and 4 replicated, in total using 100 DOC. The result is significantly (P<0,05) decreasing cholesterol and triacylglycerol levels. The best level recommendation of combination chitosan and turmeric powder is 1-2%.

Key words*: chitosan, turmeric powder, cholesterol, triacylglycerol, broiler.*

INTRODUCTION

Chitosan is a chitin derivative, a natural polymer compound which was isolated from aquaculture waste, such as shrimp shells and crab shells with a chitin content of between 65-70%. This compound was processedby chemical using sodium hidroxide or an enzymatic using a chitin deacetylase. Chitosan is a multipurpose fiber-shaped chemical and is a white, or yellow copolymer with a particle size, less than 30 μm, with specific gravity is 1.35 - 1.40 g/cm^3.

Chitosan has the ability to decrease triglyceride levels by reducing the absorption of triglycerides, as well as other lipidslike cholesterol. Reducing triglyceride absorption will affect to binding fat molecules from feed and then absorbed by the intestinal mucosa. Chitosan is capable to bindfats such as triglycerides through hydrophobic bonds as a fat absorber (Martati and Lestari, 2008).

The other function of Chitosan is an antioxidant that prevent apperances of free radicals. The activity as an antioxidant relates to amino and hydroxyl groups in the reversed position of C-2, C-3 and C-6, with unstable free radicals forming stable macromolecular radicals. Chitosan action can be assisted by turmeric powder.

Turmeric is an herbal plant that contains active compounds such as essential oils, curcumin and flavonoids. The chemical composition of turmeric is water 6.0%, protein 8.0%, carbohydrate 57.0%, crude fiber 7.0%, mineral 6.8%, volatile oil 3.0%, curcuma 3.2%, non-volatile materials 9.0% (Bintang and Nataamijaya, 2005). Chemical compounds in turmeric can reduce fat in the body through the process of bile secretion and released by feces.

According to Riyadi (2009), curcumin can improve the poultry digestive activity by preventing chain reaction, forming lipid peroxidation, and taking free hydrogen atoms, andalso reducing and arresting free radicals. Moreover, it also stimulates the gallbladder wall to secrete bile and pancreatic to release of amylases, lipases and proteases that are useful for improving digestion carbohydrates, fats, proteins, and expedite bile secretion (Agustina and Sri, 2009).

Essential oils can reduce triglyceride levels by inhibiting the action of forming triglyceride, i.e glycerol-3-phosphate derived from glycerol and dihydroxy acetone phosphate and reduced synthesize of Glycerol-3-Phosphate

dehydrogenase (GPDH) assynthesis triglyceride enzyme. This substance is also capable to decrease the activity of Glycerol-3-Phosphate dehydrogenase (GPDH), which is an enzyme in the biosynthesis of triglycerides. Increased free radical also decreases lipoprotein lipase (LPL) enzyme activity, which is causing accumulative triglyceride in liver cells and liver cell will degeneration (Goldberg, 2001). Flavonoids in turmeric can increase the activity of LPL enzymes so it can lower triglyceride levels by inhibiting the occurrence of free radicals.

According to Amic (2003), flavonoids act as antidote to free radicals, which is has hydroxyl (OH-) groups in aromatic rings and stopping lipid peroxidation chain reactions by protecting cells. The antioxidant mechanism can occured by administration of hydrogen atoms and slowrate of autoxidation.

Research on chitosan by Amrullah et al. (2010), stated that giving chitosan 1 - 1.5% can give positive effect to decrease triglyceride level and raise HDL level of duck blood. Another study by Ardi et al. (2013) demonstrated that administration of turmeric starch mixtures in rations at 1.5% level was the most efficient to increase HDL levels and lower blood triglyceride levels of broiler chickens.

Sundari et al. (2014) states that turmeric extracts of powdered dosage encapsulated with chitosan in nanoparticle size can increase the digestibility of curcumin from 46 to 70.64%. Provision of broiler chicken with a level of 0.4% significantly improves the body performance, intestinal performance, digestibility, antibiotic free meat residue, high protein, contains fatty acid eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) as well as lower abdominal fat, subcutaneous and cholesterol.

Based on the description in the above, hypothesis can be withdrawn that with the addition of 1% dosage chitosan and turmeric dose 2% of the total ration can lower levels of triglycerides and blood cholesterol.

MATERIALS AND METHODS

A total of 100 DOC's Broiler was raised during 28 days. The treatment started from second weeks until the broiler's age 28 days. The ratio from commercial with content is sufficient for broiler's maintenance and production. Energy metabolism and protein in the ratio is 3025-3125 Kcal/kg and 21.5-23.8%, respectively.

The experimental design used Completely Randomized Design (CRD), within 5 dietary treatment groups. The replicates were designated as the experimental units and were randomized with respect to the dietary treatments. The five dietary treatments were: (1) Basal ratio + 0% chitosan + 0% turmeric powder; (2) Basal ratio + 1% chitosan + 1% turmeric powder; (3) Basal ratio + 1% chitosan + 2% turmeric powder; (4) Basal ratio + 2% chitosan + 1% turmeric powder; (5) Basal ratio + 2% chitosan + 2% turmeric powder. Data will be analyzed by statistical method using Anova and continued by multiple test Duncan.

RESULTS AND DISCUSSIONS

The results in table 1 and figure 1 showed that triglyceride levels of treatment R5 were significantly different ($P<0.05$) lower than R1, but R4, R3, and R2 were significantly different ($P<0.05$) compared to R1. Levels of triglycerides between R2 and R3 were not significantly different ($P>0.05$), whereas at R5 and R4 were significantly different ($P<0.05$) lower than R2 and R3. The results can show a decrease in triglyceride levels. The above explains that the addition of a 2% chitosan and 2% turmeric mixture of the total ration reduced triglycerides, i.e 7.13 µL/mL, lower than broiler with triglyceride levels without chitosan and turmeric, i.e 14.16 µL/mL.

It can be said that giving high chitosan level on R5 (2%) can decrease blood triglyceride of broiler chicken if accompanied by giving turmeric with high level (2%). However, there is a tendency to give chitosan and turmeric with unbalanced levels (R3 and R4) and with a balanced but low level (1% each) in R2 actually increases blood triglyceride levels of broiler chickens.

Based on the results of this study can be explained that under normal conditions (without giving chitosan and turmeric), the fat contained in the diet will be decomposed into cholesterol, triglycerides, phospholipids and free fatty acids when digested and then transported by kilomicron (Linder, 2006).

Table 1. Triacylglycerol and cholesterol levels with treatment of combination chitosan and turmeric powder in broiler blood lipid profile

Parameter	R1	R2	R3	R4	R5
Triacyl-glycerol (µL/mL)	14.16 ± 2.69[b]	35.90 ± 1.56[d]	35.86 ± 2.18[d]	19.75 ± 3.94[c]	7.13 ± 0.53[a]
Cholesterol (µL/mL)	35.09± 2.42[e]	22.07± 0.57[c]	12.81± 0.71[a]	25.14± 0.91[d]	14.89± 0.46[b]

Kilomicron will bring triglycerides and cholesterol into the bloodstream, then triglycerides in kilomicrons are decomposed by lipoprotein lipase enzymes to form free fatty acids and kilomicron remains. Kilomicron will enter the lymphatic system and will eventually lead to blood flow, which ishydrolyzed by lipoprotein lipase into free fatty acids. The free fatty acids will be absorbed by the vascular endothelium and partially stored in the adipose tissue in the form of triglycerides. Some triglycerides will be taken by the liver to form liver triglycerides if they are in large quantities. Liver triglycerides are secreted into the blood circulation in the form of VLDL (Very Low Density Lipoprotein) (Linder, 2006). Based on these facts that cause blood triglyceride levels without chitosan and turmeric treatment (R1) is quite high compared to R5.

High triglyceride levels with chitosan on R4, R3 and R2 may be due to increased feed digestibility by chitosan (Huang et al., 2005). Xu et al. (2013) also reported that giving chitosan at a certain level actually causes improving the rhythm or metabolic rate. This means that chitosan causes anabolic metabolism was increased, so the synthesis of triglycerides from fatty acids also increased. This condition is also stimulated by the action of turmeric powder, as Bengmark et al. (2009) reported that curcumin with a level that is not too high can improve the efficiency of rations, stimulate anabolism, causing adipose tissue to increase. This is because the content of the substance curcuminoids and essential oils in turmeric is effectively absorbed by intestinal epithelial cells, thus affecting metabolism.

According to the results of this study, the combination of chitosan and turmeric flour with a certain level (R2, R3, and R4) actually increase the formation of triglycerides. The decrease of chicken blood triglyceride level drastically by treatment of R5 (2% chitosan + 2% turmeric flour) is 7.13 µL/mL because of the ability of essential oil to decrease Glycerol-3-Phosphate Dehydrogenase (GPDH) activity, that is enzyme that play a role in triglyceride synthesis. Inhibition of triglyceride synthesis in the liver and small intestine will result in a decrease in blood triglyceride levels (He et al., 2009).

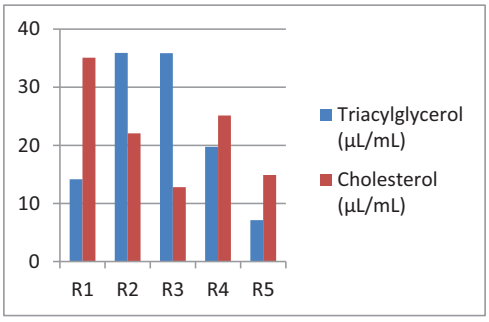

Figure 1. Level of triacylglicerol and cholesterol in 5 dietary treatment of combination chitosan and turmeric powder

The activity of this enzyme (GPDH) increases because it was supported by the giving of chitosan with high level (2%). Huang et al. (2005) showed that chitosan can improve the condition of intestine acidity as the impact of oligosaccharide reform from chitosan by lactate bacteria in intestine. Xu et al. (2013) showed that the morphology of intestine looked better with chitosan and increased absorption of macro and micro minerals as a result of increased acidity in the intestine. It was further reported that the activity of hormones and enzymes increased as a simulated effect of minerals absorbed passed the intestine

The presence of tannins in turmeric can also lead to the occurrence of coatingsintestinal membrane to inhibit the absorption of nutrients. The tannins in the body bind proteins and will coat the intestinal wall, forming a layer of mucus in the digestive tract and inhibiting the absorption of nutrients, including triglycerides (Adriani, 2014). Based on that the combination of chitosan and turmeric flour with the right dose decreases triglyceride levels. Conversely, an incorrect combination of doses actually can increases triglycerides.

Chitosan and turmeric powder can basically lower blood cholesterol levels by different mechanisms. Chitosan as a natural fiber can

lower cholesterol levels that work in the intestine, because the fiber was hard absorbed by the intestine. The role of dietary fiber is to increase the production of bile acids for excretion.

Wolever (1997) states the mechanisms of cholesterol reduction by fiber caused by binding of bile acids in the small intestine which can lead to increased excretion of fecal bile acids, decreased absorption of fat and cholesterol. Thus, can decreased carbohydrate absorption with resulting in decreased serum insulin levels and decreasing stimulation of cholesterol synthesis and lipropotein. Decreased insulin can slow the activity of HMG-CoA reductase so that cholesterol formation can be slowed too (Murray, 2014).

The role of turmeric as a cholesterol-lowering mechanism can be understood considering turmeric contains substances that can lower cholesterol levels.

The content of these substances such as curcumin and essential oils. Curcumin is a phenol compound that can increase the secretion of bile acids. A decrease in cholesterol levels through bile acid secretion is a major route in cholesterol excretion, a pathway called enterohepatic circulation. Bile acids are formed from cholesterol and synthesized in the liver. Most of the released bile acids will be reabsorbed by the small intestine in the ileum (98-99%) and the rest will be excreted by the feces (Murray, 2014).

Essential oils can lower blood cholesterol levels of broiler chickens. This decrease resulted from HMG-CoA reductase inhibited its performance. The inhibitory properties of essential oils are similar to the use of statin substances such as simvastatin (Murray, 2014). The results showed that the treatment of R3 (1% chitosan + 2% turmeric flour) was the most optimal treatment to lower blood cholesterol levels compared with other treatments.

Related to this can be explained that R3 is the best level in lowering blood cholesterol, this is in accordance with the results of research Zhou et al. (2009), that giving chitosan with higher levels can lower total cholesterol but increase LDL (Low Density Lipoprotein) cholesterol. It is known that LDL plays a role in transporting cholesterol from the liver tissue to all body cells. This means that chitosan with a high level of 2% (R4 and R5) is the cause of increased blood cholesterol levels. Similar results were also reported by Lim et al. (2006), higher cholesterol levels with increased chitosan levels in broiler chickens.

Giving of 2% turmeric with 2% chitosan combination still shows higher cholesterol level compared to R3 because turmeric also stimulates the increase of HDL (High Density Lipoprotein) cholesterol (Claeson et al., 1993). However, the dominance effect of chitosan is higher with increasing LDL levels than HDL (Lee et al., 2001).

CONCLUSIONS

In conclusion, there was decreased in cholesterol and blood triglyceride levels which significantly increased the mixture of chitosan and turmeric supplementation. The mixture of chitosan supplementation 1% and 2% turmeric starch (R3) showed the lowest blood cholesterol level (12,81 µL/mL), however the mixture of chitosan supplementation 2% and 2% turmeric flour (R5) showed the lowest tryacilglycerol level (7.13 ± 0.53 µL/mL) compared with other treatments.

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