Decreased Triglyceride and Cholesterol Levels in Serum, Liver and Breast Muscle in Broiler by the Supplementation of Dietary *Codonopsis lanceolata* Root*

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ABSTRACT : Effects of the dietary supplementation of *Codonopsis lanceolata* root on triglyceride and cholesterol levels in the serum, liver, breast muscle and bile in male Cobb×Cobb chicks were investigated. The chicks (15-42 days old) were fed diets supplemented with 0, 0.25 and 0.5% *Codonopsis lanceolata* root. No differences were observed in body weight, feed conversion ratio, gall bladder weight or abdominal fat deposition among the control group and the two treatment groups. Liver weights were higher in chicks fed a 0.5% *Codonopsis lanceolata* diet than in those fed the control diet ($p<0.05$). However, serum levels of both glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) were not different among the three groups. Broiler chicks fed either 0.25% or 0.5% dietary *Codonopsis lanceolata* root showed decreased serum levels of triglyceride, total cholesterol and low density lipoprotein cholesterol compared to the control group ($p<0.05$). Supplementation with either 0.25% or 0.5% dietary *Codonopsis lanceolata* root decreased the triglyceride and total cholesterol levels in liver and breast muscle compared to the control group ($p<0.05$). Biliary cholesterol increased by 15% in chicks fed 0.5% dietary *Codonopsis lanceolata* root, suggesting that the biliary excretion of cholesterol had been elevated by dietary *Codonopsis lanceolata* root ($p<0.05$). In conclusion, these results indicate that dietary *Codonopsis lanceolata* root can decrease triglyceride and cholesterol levels in the serum, liver and breast muscle of broilers. ***(Asian-Aust. J. Anim. Sci. 2004. Vol 17, No. 4 : 511-513)***

Key Words : *Codonopsis lanceolata*, Broiler, Cholesterol, Triglyceride, Serum, Liver, Bile, Breast Muscle

INTRODUCTION

The root of *Codonopsis lanceolata*, which is well-known in traditional Korean and Chinese medicine, is often utilized as a herbal medicine to treat bronchitis, coughs, spasms, low blood pressure and inflammation (Lee, 1985). Several investigations conducted on *Codonopsis lanceolata* root have reported upon its antioxidant effects (Maeng and Park, 1991; Han and Cho, 1997), its use in treating chronic hepatitis B (Zhang et al., 1993), and its effect on cellular immune responses (Zneg et al., 1992; Lee et al., 1995).

A few studies have focused particular attention on the effects of dietary *Codonopsis lanceolata* root on lipid and cholesterol metabolism (Kim et al., 1993; Han et al., 1998). For example, Kim et al. (1993) reported that triglyceride and cholesterol levels were markedly reduced in rat serum and liver in animals fed a diet supplemented with 5% *Codonopsis lanceolata* powder containing 10% perilla and safflower oil. Similar effects were found in rats fed *Codonopsis lanceolata* water extract (Han et al., 1998). The reduction in triglyceride and cholesterol levels by dietary *Codonopsis lanceolata* root has only been shown in rats, but no previous research has been conducted in broiler chicks. Because of the relationship between triglyceride and cholesterol intakes and coronary heart disease, lowered triglyceride and cholesterol levels in poultry meat products would be beneficial to consumers by reducing the risk of ischemic heart disease. Therefore, the purpose of our study was to investigate the effect of the dietary supplementation of *Codonopsis lanceolata* root on the triglyceride and cholesterol levels in the serum, liver, breast muscle and bile of broiler chicks.

MATERIALS AND METHODS

Six hundred newly hatched male broilers were obtained from a commercial hatchery. After weighing, the birds were wing-banded, placed in electrically heated battery brooders and raised on commercial diets. At 15 days of age, 135 chicks with similar body weights (475±2.8 g) were selected from the flock, equally assigned to nine temperature-controlled floor pens (1.1×1.3 m) containing 15 birds each. One pen represented a replicate and three replicates were randomly allocated to each of the three treatments. The three treatment diets consisted of a commercial basal diet of 19% CP, 3,000 kcal ME/kg supplemented with 0, 0.25 and

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Table 1. The effects of dietary *Codonopsis lanceolata* root on body weight, feed conversion ratio, and weights of liver, abdominal fat and gall bladder[1]

Items	*Codonopsis lanceolata* root level		
	0%	0.25%	0.50%
Body weight, g/bird	1,931±16	1,914±18	1,912±21
Feed/gain	1.62±0.01	1.69±0.03	1.64±0.01
Liver weight, g/bird	30.9±0.48 [a]	31.0±0.50 [a]	32.7±0.57 [b]
Abdominal fat weight, g/bird	28.4±0.73	29.6±1.16	26.6±0.83
Gall bladder weight, g/brid	1.98±0.07	2.06±0.08	1.95±0.06

[1] Values are means±SE. [a, b] Means within a row with no common superscript differ significantly ($p<0.05$).

Table 2. Effect of dietary *Codonopsis lanceolata* root on the levels of GOT and GPT in chick serum[1]

Items	*Codonopsis lanceolata* root level		
	0%	0.25%	0.50%
GOT[2], IU/L	110±4.2	116±3.3	110 ±3.3
GPT[3], IU/L	3.7±0.13	3.7±0.16	3.7±0.16

[1] Values are means±SE. [2] GOT=glutamic oxaloacetic transaminase.
[3] GPT=glutamic pyruvic transaminase.

0.5% dried *Codonopsis lanceolata* root powder. Feeds and water were provided *ad libitum* and lighting was provided continuously throughout the experimental period.

At 42 days of age, birds were weighed individually and feed intake was determined in group. After 24 h fasting, blood samples was take from one bird in each replicate through jugular vein and serum separated. The chicks were decapitated and livers and gall bladders removed and weighed. The abdominal fat was isolated as described in Kim and Park (2002). The breast muscle samples were also collected. The serum, liver, bile and breast muscle samples were stored at -20°C for further analysis.

Serum concentrations of glutamic oxaloacetic transaminase (GOT), glutamic pyruvic transaminase (GPT), triglyceride, total cholesterol and high density lipoprotein (HDL) cholesterol were measured using analytical kits (Asan Pharm. Co., Ltd. Seoul, Korea). Serum concentration of low density lipoprotein (LDL) cholesterol was determined as described by Friedewald et al. (1972). Extractions of total lipid from the liver, bile and breast muscle were conducted as described by Folch et al. (1957). The contents of the lipid extracted were determined as described by Bligh and Dyer (1959). The concentrations of cholesterol or triglyceride in the lipid extracted from liver, bile and breast muscle were also determined using analytical kits (Asan Pharm. Co., Ltd. Seoul, Korea).

All samples were analyzed simultaneously to eliminate variances due to the storage and handling of samples prepared at different times. Data were analyzed by using Duncan's new multiple range test to determine the significance of treatment effects (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The effects of dietary *Codonopsis lanceolata* root on body weight, feed conversion ratio and liver, abdominal fat and gall bladder weights are shown in Table 1. Supplementation with *Codonopsis lanceolata* root had no effect on body weight and feed conversion ratio. In addition, the amount of abdominal fat and gall bladder weights were not different among the control and the two treatment groups. However, the liver weights of chicks fed the 0.5% *Codonopsis lanceolata* root diet were significantly heavier than those of the control group ($p<0.05$).

The increased liver weight by 0.5% *Codonopsis lanceolata* root diet might be associated with liver damage. Thus, serum levels of GOT and GPT, which are clinically useful for assessing liver cell damage (Reichling et al., 1988), were measured. As shown in Table 2, the serum levels of GOT and of GPT were not significantly different among the three groups. Therefore, it is unlikely that the supplementation of *Codonopsis lanceolata* root up to 0.5% induced liver damage in the chicks.

Table 3 shows the various lipid fractions in serum, liver, breast muscle and bile. In serum, concentrations of triglyceride, total cholesterol and LDL-cholesterol were significantly lower in chicks fed diets supplemented with *Codonopsis lanceolata* root than those of the control group ($p<0.05$). Serum concentrations of HDL-cholesterol appeared to increase as the amount of *Codonopsis lanceolata* root increased, but the difference was not significant. *Codonopsis lanceolata* root supplementation decreased the liver concentrations of total lipid, triglyceride and total cholesterol ($p<0.05$). However, dietary *Codonopsis lanceolata* root supplementation had no effect on the level of total lipid in muscle. It was found that the amounts of triglyceride and total cholesterol in muscle were lower in chicks fed diets containing *Codonopsis lanceolata* root than those in control chicks ($p<0.05$). These results are similar to those of previous studies, in which reductions of triglyceride and cholesterol concentrations in both the serum and the liver of rats fed *Codonopsis lanceolata* diets or *Codonopsis lanceolata* water extracts were observed (Kim et al., 1993; Han et al., 1998).

The concentrations of total biliary lipid and cholesterol were also measured to investigate whether these decreases in the levels of lipid fractions are related to biliary lipid excretion. As shown in Table 3, dietary *Codonopsis*

Table 3. Effect of dietary *Codonopsis lanceolata* root on the lipid fractions of chick serum, liver, breast muscle and bile[1]

Items	*Codonopsis lanceolata* root level		
	0%	0.25%	0.50%
Serum			
Triglyceride, mg/dl	47.7±1.4[a]	41.9±1.3[b]	38.5±1.1[b]
Total cholesterol, mg/dl	162±5.5[a]	142±3.2[b]	143±3.2[b]
HDL-cholesterol, mg/dl	64.8±2.7	66.7±2.4	70.7±2.3
LDL-cholesterol, mg/dl	87.3±5.2[a]	67.2±2.5[b]	64.6±3.6[b]
Liver			
Total lipid, %	5.4±0.09[a]	5.0±0.07[b]	4.7±0.08[c]
Triglyceride, mg/g wet tissue	9.0±0.60[a]	6.7±0.33[b]	5.8±0.19[b]
Total cholesterol, mg/g wet tissue	3.5±0.07[a]	3.3±0.06[a]	3.1±0.05[b]
Breast muscle			
Total lipid, %	1.5±0.10	1.4±0.07	1.4±0.06
Triglyceride, mg/g wet tissue	5.08±0.41[a]	4.08±0.30[b]	3.68±0.26[b]
Total cholesterol, mg/g wet tissue	0.65±0.01[a]	0.64±0.01[ab]	0.61±0.01[b]
Bile			
Total lipid, %	3.4±0.17[ab]	3.1±0.11[a]	3.5±0.16[b]
Total cholesterol, mg/dl	52.2±2.3[a]	55.5±2.3[a]	60.0±2.8[b]

[1] Values are means±SE. [a, b] Means within a row with no common superscript differ significantly ($p<0.05$).

lanceolata root supplementation had no effect on the level of total biliary lipid. However, the level of total biliary cholesterol increased in chicks fed the 0.5% *Codonopsis lanceolata* root diet by 15% compared to the control ($p<0.05$). This data indicates that the supplementation of dietary *Codonopsis lanceolata* root accelerates the excretion of cholesterol via bile. Decreases in the cholesterol levels of the various tissues were related to the elevated biliary excretion of cholesterol after dietary *Codonopsis lanceolata* root supplementation.

In conclusion, dietary supplementation of *Codonopsis lanceolata* root could decrease triglyceride and cholesterol levels in chick serum, liver and breast muscle. It is postulated that one of the mechanisms responsible for this observed decrease in cholesterol level in chicks is via elevated biliary cholesterol excretion. Therefore, the dietary supplementation of *Codonopsis lanceolata* root could lead to the development of low-cholesterol poultry products as demanded by health-conscious consumers.

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