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The effects of *saccharomyces cervisiae* beta-glucan on blood lipids in broiler chickens

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ABSTRACT

*For healthy and antibiotic free chicken meat products, use of antibiotics alternatives has been suggested. There was a little study about saccharomyces cervisiae beta-glucan effects on the broiler chicken, thus this experiment was undertaken to examine the effects of beta-glucan on serum total cholesterol, triglyceride and HDL. A total of 144 one day-old Ross-308 chicks (72 males and 72 females) divided into 18 groups (6 treatment and 3 replicate pens per treatment), and rations were balanced according to the Ross-308 guide catalogue. From first day, beta-glucan was added to diets. Data were analyzed based on a 2*3*3 factorial design with 2 sampling days (24 and 35 d), 2 bird sexes (male and female) and 3 concentration of beta-glucan (0, 0.04 and 0.08%). At the 24 and 35 days of the experiment, 6 birds per treatment (two from each pen) were randomly chosen and slaughtered. Birds fed beta-glucan containing diets exhibited significantly effects on serum triglyceride and exhibited no effects on serum cholesterol and HDL. We found significantly effect on serum HDL in the male birds and in the female chicken, there was a significantly effect on serum total cholesterol and triglyceride. As well as we observed a significantly effect on serum HDL at the first sampling day (day 24) and at the second sampling day (day 35), there was a significantly effect on serum triglyceride and total cholesterol.*

Keywords: Saccharomyces Cervisiae, beta-glucan, prebiotic, blood lipids, broiler chicken.

INTRODUCTION

The broiler's economical production is very important and feed is the important factor that affecting the productive performance and economical production of broilers. Certain feed additives incorporated in the poultry diets can create favorable conditions in intestine for efficient digestion of feed. Various kinds of such feed additives that can be used as growth promoters are probiotics, prebiotics, acidifiers, etc [18]. A prebiotic is a nondigestible food ingredient which beneficially affects the host by selectively stimulating the growth and/or activity of one or limited number of bacteria in the colon and thus improving host health [34, 21, 15, 6, 22, 16, 10, 9]. The lipid and cholesterol lowering effects of prebiotics could be attributed to the short chain fatty acids (SCFA). It is commonly known that prebiotics resist digestion in the small intestine and reach the colon, where they are fermented by selective colonic microflora to produce SCFA such as acetate, propionate and lactate [14]. Many studies have used rats, mice, hamsters, guinea pigs and pigs as models due to their similarities with humans in terms of cholesterol and bile acid metabolism, plasma lipoprotein distribution and regulation of hepatic cholesterol enzymes [8, 17, 23, 26, 7]. Beta-glucan is a specific fiber-type complex polysaccharide which can be derived from the cell wall of baker's yeast, oat and barley, and many medical mushrooms such as Maitake and lin Zhi [33]. Yeast beta-glucans appear to be effective in the reduction of blood cholesterol concentrations [25]. Barley beta-glucan fiber has been shown to reduce total and LDL cholesterol [28].

The present experiment was designed to test the hypothesis that the addition of an optimum level of *saccharomayces cervisiae* beta-glucan to broiler chicken diets had lowering effect on blood lipids in broiler chickens.

MATERIALS AND METHODS

A total of 144 one-day old Ross-308 broiler chicks (72 male and 72 female) were divided in to 18 pens. The experiment was designed in 6 treatments, including 2 sexes and 3 levels of beta-glucan, and 3 replications for each treatment. The levels of beta-glucan in the experiment were 0 (control), 0.04% and 0.08%. Beta-glucan extracted from saccharomyces cervisiae was provided by CHANGSHA INNER NATURAL INC. (INNER®). Diets were formulated for starter (1-10 d), grower (11-22 d) and finisher (23-36 d) periods based on nutritional requirement tables of the Ross-308 management guide (2008). Beta-glucan was added in to diets from first day of age. At the end of grower and finisher periods, two birds of each pens were randomly slaughtered and blood samples directly accomplished from jugular vein. Blood samples were remained at room temperature for 1 hour then centrifuged at 3000 rpm for 15 minute then blood serum was separated, serums were transferred to -20°c freezer for 24 hour then transferred to -60°c freezer until use. At test day, samples were leaved from refrigerator temperature for 24 hour until melting then total cholesterol, HDL-cholesterol, LDL-cholesterol, VLDL-cholesterol and triglyceride of serum samples measured by auto analyzer machine (ALCYON 300, U.S.A). Data were analyzed based on a 2*2*3 factorial design, 2 level for sex, 2 time for sampling day (24 and 35 d of age) and 3 levels for beta-glucan. Data were subjected to ANOVA using the GLM procedure of SAS (v.9.1 software). Pens means served as an experimental unit for statistical analysis. Means were separated following Duncan's Multiple Range Test. Orthogonal contrast of the GLM procedure was used to determine significant linear or quadratic relationship between the beta-glucan levels and determined parameters.

RESULTS AND DISCUSSION

Total Cholesterol

There was no significant difference (P<0.05), between several levels of beta-glucan on total cholesterol (Table 1). This result is corresponded with a recent in study which 18 men with mildly high cholesterol, the addition of a beta-glucan enriched form of barely (8.1-11.9 g of beta-glucan per day) to diets with 38% of the calories from fat did not result in significant changes in blood lipid measurements [28]. Lou et al. (1996) reported that consumption of 20 g/d fructooligosaccharid (FOS) has not significant effects on blood lipids. Van-Dokkum et al. (1999) also represented that utilization of inulin and FOS had not significant variation on total cholesterol. In another study designed by Letexier et al. (2003) consumption of inulin-HP and placebo had not significant changes on total cholesterol levels. Pederson et al. (1997) also studied the effect of 14g/d inulin on blood lipids in 64 healthy females. Based on the results, inulin provided not statistically significant changes in total cholesterol. In the study by Boutron-Ruault (2005) after 3 months of FOS supplementation, no statistically significant differences were observed in total cholesterol. Luo et al. (2000) investigated the effect of 20g/d FOS on lipids in 10 subjects with type 2 diabetes, in that, no statistically significant differences were observed for total cholesterol. Another study reported that the use of pribiotic, prebiotic or complex of them has no significant effect on total cholesterol in quails [30]. Ahmdifar et al. (2010) also, reported that consumption of several levels of inulin had no significant effect on total cholesterol in Huso huso. Rekiel et al. (2007) notified that the use of prebiotic (BIO-MOS) had no significant effect on total cholesterol in pigs.

Table 1: Mean comparison of some beta-glucan levels on the measured factors

Blood parameter (mg/dl)	0%beta-glucan	0.04%beta-glucan	0.08%beta-glucan	P-value
		means		
Triglyceride	78.250[b]	88.417[a]	68.833[c]	<0.0001
Total cholesterol	115.250[a]	113.667[a]	116.0[a]	0.4249
HDL	54.733[a]	54.150[a]	55.367[a]	0.7402

[a,b,c] *Row means with various alphabet marks have significant differences (P<0.05)*

But our finding is disagree with Brighenti et al. (1999) reported that 50g/d cereal containing 18% inulin, significantly decline total cholesterol. In a study, conducted by Moretnsen et al. (2002) it was found that containing 10% long chain fructan had significant decrease in total cholesterol concentration. Pins and Kaur (2006), in another study, reported that, diet contain wheat (1.5 g/d beta-glucan) versus diet contain barley (8g/d beta-glucan) showed a significant decline in total cholesterol level. HongZhen et al. (2009) realized that barley derived beta-glucan induced appreciable decline in mice total cholesterol. Balcazar-Mounz et al. (2003) reported that the use of 7 g/d inulin, induced significant decrease in total cholesterol.

Means comparison results, showed that there is a significant variation between male and female birds for total cholesterol, as males total cholesterol had a significant increase than females total cholesterol level (Table 2).

Table 2: Mean comparison of male and female birds for measured factors

Blood parameter (mg/dl)	Male birds	Female birds	P-value
	means		
Triglyceride	88.611[a]	68.389[b]	<0.0001
Total cholesterol	117.444[a]	112.500[b]	0.0024
HDL	56.978[a]	52.522[b]	0.0018

[a,b] *Row means with various alphabet marks have significant differences (P<0.05)*

In the present study, we manifested a significant variation between two period of sampling, as total cholesterol level in second sampling period (day 34) had significant decline versus first (day 17) sampling period (Table 3).

There was a significant linear relationship between total cholesterol and beta-glucan levels (P= 0.0305).

Table 3: Mean comparison of sampling days effect for measured factors

Blood parameter (mg/dl)	Day 24	Day 35	P-value
	means		
Triglyceride	97.944[a]	59.056[b]	<0.0001
Total cholesterol	122.833[a]	107.111[b]	<0.0001
HDL	59.056[a]	50.444[b]	<0.0001

[a,b] *Row means with various alphabet marks have significant differences (P<0.05)*

Triglyceride

There was a significant difference (P<0.05) between all experimental groups for triglyceride (Table1). Therefore, adding 0.04% beta-glucan to diet, increased serum triglyceride against control group and adding 0.08% beta-glucan to diet, decreased serum triglyceride against control group. Our finding is agree with Causey et al. (2000) reported that daily intake of 20g of inulin, significantly reduced serum triglycerides. In another study the authors found that the daily consumption of 50g of cereal containing 18% inulin, significantly reduced plasma triglycerides [4]. Similarly Wang et al. (2008) found that ten male wistar rats fed with a starch from Chinese yam for 8 weeks showed a significantly lower plasma triglyceride than control. HongZhen et al. (2009) found that barely beta-glucan gets significantly decrease in mice serum triglyceride.

In contrast, Pedersen et al. (1997) reported that the use of 14g/d inulin had not significant effect on triglyceride amount. Luo et al. (2000) showed that the use of 20g/d fructooligosaccharide had no significant effect on triglyceride level.

We found that there is a significant variation between males and females for triglyceride level, as males triglyceride level had a significant increase than females triglyceride level (Table 2).

In the present study, we manifested a significant variation between two period of sampling, as triglyceride level in second sampling period (day 34) had significant decline versus first (day 17) sampling period (Table 3).

There was not a significant linear relationship between triglyceride and beta-glucan levels (P= 0.2003).

HDL

There was no significant effect (P<0.05) between all experimental groups for HDL (Table1). Therefore use of beta-glucan had no effect on HDL. Our finding is agree with Letexier et al. (2003) reported that the use of 10g/d inulin-HP, had no significant effect on HDL. Also Pedersen et al. (1997) showed that the use of 14g/d inulin by women had no significant effect on HDL. Luo et al. (2000) also reported that apply 20g/d fructooligosaccharide had no significant change on HDL level. Boutron-Ruault et al. (2005) were observed, no statistically significant differences in HDL, after 3 months of FOS application.

In contrast, Kim and Shin (1998) reported that the use of inulin for 4 weeks, decrease serum HDL level, similarly HongZhen et al(2009) found that barel beta-glucan increased HDL level in mice.

In this study, comparison of means, showed that there is a significant variation between males and females for HDL, as males HDL level had a significant increase than females HDL level (Table 2).

In the present study, we manifested a significant variation between two period of sampling, as HDL level in second sampling period (day 34) had significant decline versus first (day 17) sampling period (Table 3).

There was not a significant linear relationship between HDL and beta-glucan levels (P= 0.1598).

CONCLUSION

1- Beta-glucan has no effect on serum cholesterol.
2- Adding 0.08% beta-glucan to diet, decreased serum triglyceride level.
3- Beta-glucan has no effect on blood HDL level.

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