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A Study on the Effect of Cinnamon Powder in Diet on Serum Glucose Level in Broiler Chicks

[1]*Reza Rezaie Koochaksaraie,* [1]*Mehrdad Irani,* [1]*Mohammad Reza Valizadeh,*
[2]*Zahra Rahmani and* [1]*Shahabodin Gharahveysi*

[1]Islamic Azad University, Qaemshahr Branch, Iran
[2]Medical Science University of Mazandaran, Sari, Iran

Abstract: Chickens have a blood glucose level that is twice as high as that of most mammals and are resistant against hypoglycemia. This study was conducted to investigate the effect of Cinnamon powder (CP) in broiler diet on serum glucose level. Different levels of CP were added to a standard diet to determine its effects on serum glucose level. There were five treatments: a negative control diet without the additive (T_1), 250 mg/kg (T_2), 500 mg/kg (T_3), 1000 mg/kg (T_4) and 2000 mg/kg (T_5) CP in diet. A total of 320 one-day-old mixed-sex broilers (of the breed Ross 308) were distributed into 16 pens with 20 chickens in each one, comprising 3 replicates per treatment (except for T_1, which had 4 replicates). We conducted the experiment in an unbalanced completely randomized design. The diets were prepared freshly each day. Broiler chickens were grown under standard conditions from 1 to 4 days of age and then CP was added to their diet from 4 to 7 days of age. On day 7, two chickens from each replicate pen were selected randomly and their medial metatarsal vein blood sample was obtained. The results of this experiment indicated that there is no statistically significant difference among treatments.

Key words: Broiler · Cinnamon Powder · Hypoglycemia · Glucose

INTRODUCTION

Plasma glucose concentrations in bird species are 150-300% higher than in mammals of similar body mass [1-3]. Glucose is utilized by birds for a variety of functions, with the main use being energy production through cellular oxidation, glycogen synthesis in the liver and glycolytic muscles, fatty acid synthesis as well as synthesis of nonessential amino acids, vitamin C and other metabolites. Despite the normal concentraion of blood insulin in birds, chickens resemble type 2 human diabetic because they have high blood glucose levels and show low sensitivity to exogenous insulin [4-6]. Birds have a high metabolic rate and glucose level, high growth rate and capacity of fat deposition, making broiler muscle an interesting model of insulin resistance.

More than 400 species of plants with blood glucose lowering property are known, one of which is the Cinnamon [7]. Cinnamon belongs to the Lauracea family, in which the genus *Cinnamomum* comprises approximately 250 species which are widely distributed in China, India and Australia [8]. Khan *et al.* [9] isolated an unidentified factor from cinnamon and called it "insulin potentiating factor" (IPF). They demonstrated that IPF increased the activity of insulin 3 fold in glucose metabolism in rat epididymal fat cells. Anderson [10] characterized this unidentified factor present in cinnamon as methyl hydroxy chalcone polymers (MHCP). They reported that MHCP presented in cinnamon increased insulin dependent glucose metabolism roughly 20 fold *in vitro*.

Some research has suggested that cinnamon may be effective for improving blood glucose control in type 2 diabetics [11-13]. Khan [12] compared fasting serum glucose levels in 60 type 2 diabetics. Taking cinnamon caused a statistically significant decrease in fasting serum glucose level (from a mean of 326 to 175 mg/dl), not observed with the placebo.

To date, no clear research has investigated the effect of cinnamon powder on serum glucose level in broilers. Since blood glucose levels in birds and type 2 dibetics are high, the purpose of this experiment was to investigate the hypoglycemic effect of cinnamon in birds.

Corresponding Author: Reza Rezaie Koochaksaraie, Islamic Azad University, Qaemshahr Branch, Iran
E-mail: reza_rezaie62@yahoo.com & s.gharavysi@Googlemail.com.

MATERIALS AND METHODS

Three hundred and twenty one-day-old mixed sex broiler chicks (of the breed Ross 308) were used in this study. They were assigned to five treatment groups. Each group had 3 replicates, except the control group which had 4 replicates. The chicks were housed in floor pens (2 × 1 m) and each pen included 20 chicks. The study was conducted for 7 days and the diet of 21.22% crude protein and 2950 Kcal/Kg ME was offered ad-libitum from day 1 to day 7. This diet was formulated to cover the nutrient requirements of chickens [14]. The ingredients and the composition of the experimental diet are shown in Table 1. The required amount of cinnamon was purchased from the local market and ground finely. Powderized cinnamon was added in base diet according to dosage. No CP (control group), 250 mg/kg CP in diet (T_2), 500 mg/kg CP in diet (T_3), 1000 mg/ kg CP in diet (T_4) and 2000 mg/kg CP in diet (T_5). The birds were fed cinnamon for 3 days (the cinnamon was added the diet after 4 days of rearing).

Table 1: Composition of the experimental diet

Feed Ingredients (%)	day 1 to day 7
Corn	57
Soybean meal (CP 43%)	32.45
Fish meal	5.11
Soybean oil	2
Dicalcium Phosphate	0.63
Ground Limestone	1.03
Salt	0.18
DL-Methionine	0.16
L-Lysine	0.03
NaHCO3	0.21
Vitamin permix1	0.25
Mineral permix2	0.25
Vit A	0.2
Vit B	0.1
Vit D	0.1
Vit E	0.2
Vit k	0.1
Total	*100.00*
ME (kcal/kg)	2950.00
CP (%)	21.22
Lysine (%)	1.21
Ca (%)	.92
P (%) Available	.41

1. Permix vitamin content per kilogram of diet: 1.8 g vitamin A (500000 IU/g); 0.4 g vitamin D3 (500000 IU/g); 3.6 g vitamin E (500 IU/g); 0.4 g vitamin k3 (50%); 0.18 g vitamin B_1 (98.56%); 0.825 g vitamin B_2 (80%); 1 g vitamin B_5 (98%); 0.3 g vitamin B_6 (98.2%); 98.2 g vitamin B_{12} (1%); 0.125 g vitamin B_9 (80%); 3 g vitamin B_5 (99%); 0.5 g vitamin H_2 (2%) and 10 g antioxidant.
2. Mineral permix supplied per kilogram of diet: 100 g cholin chloride (50%); 16 g MgO (62%); 25 g $FeSO_4{}^{7H}{}_2O$ (20%); 11 g ZnO (77%); 25 g $CuSO_4{}^{6H}{}_2O$ (20%); 16 g $Ca(IO_3)2.H_2O$ (62%) and 2 g Se (1%).
3. Vitamins are consisted of: 5500 IU/kg E; 5 IU/kg K_3; 5000000 IU/kg D_3 and 5000000 IU/kg A.
4. Vitamin B group consisted of: 1500 mg B_1; 4000 mg B_2; 10000 mg B_3; 20000 mg B_5; 200 mg B_6; 500 mg Folic acid (80%); 20 mg B_{12}; 70 mg H_2; 150 g Choline chloride and 100 g Betaine.

On the 7th days blood samples one drop were obtained from 2 healthy birds in each pen by taking the blood from the medial metatarsal vein. Blood glucose was determined by the glucose oxidase method using a glucometer ($Rightest_{TM}$ $^{GM}{}_{300}$) [19]. Values obtained using the glucometer have been shown to correlate excellently with those obtained in standard biochemical methods [15, 16]. Glocometer was used in this experiment because of its high speed and also in order to lower the stress of chickens. This research was conducted in an unbalanced completely randomized design. Data were analyzed by using SAS and Duncan's multiple range test was used to detect the differences ($P<0.05$) among different group means [17, 18].

RESULTS AND DISCUSSION

The effect of cinnamon powder in the diet on serum glucose level of broiler chicks is shown in Table 2. There is no statistically significant difference among treatments; however, dietary addition of cinnamon, 250 mg/kg diet (T2), broiler chicken feed for 3 days significantly increased plasma glucose level ($P<0.05$) compared with T3. Several recent studies have reported the hypoglycemic effect of cinnamon in diabetics. For example, Subash [20] found that cinnamaldehyde in *C. zeylanicum* was effective in decreasing plasma glucose concentration and increasing plasma insulin in streptozotonic-induced male diabetic waster rats. In addition, Javrill-Taylor *et al.* [21] concluded from their study that a methyl hydroxy chalcone polymer (MHCP) was an effective insulin-like substance. MHCP might be useful in the treatment of insulin resistance and in the study of the pathways leading to glucose utilization in cells. Also Khan *et al.* reported the benefiicial effect of cinnamon in fasting serum glucose levels in type 2 diabetics [12]. Mang *et al.* [13] used 3 g/day cinnamon that improved fasting blood glucose in *diabetes mellitus* type 2. On the other hand, Vanschoobeek *et al.* [22] reported that cinnamon supplementation (1.5 g/d) does not improve fasting blood glucose in type 2 diabetics.

Table 2: Effect of different level of cinnamon powder on serum glucose in broiler chickens

Item	T1	T2	T3	T4	T5
Glucose (mg/dl)	292.5 ab	305.8 a	247.5 b	291.1 ab	274.5 ab
SE (Control)	14.1				
SE (Other treatments)	16.3				

Broiler chickens were grown under standard conditions from day 1 to day 4 of age and then fed diet containing these levels of cinnamon powder from 4 to 7 days of age.

T1: Control, T2: 250 mg, T3: 500 mg, T4: 1000mg and T5: 2000mg CP in per Kg diet.

Means in each column followed by the same letters are not significantly different at 0.05.

Birds maintain very high plasma glucose levels compared to mammals of similar body mass and are resistant to the glucose lowering effects of insulin [23-28]. In addition, domestic fowl are known for their insulin resistance because massive doses of insulin, which would be lethal to mammals, do not cause hypoglycemic convulsions in chickens [29]. Moreover, large doses of insulin are required for glucose uptake in insulin responsive tissues in chickens [30]. There is some difference in glucose homeostasis in birds compared with mammals. In aves, glucagon plays the major and deciding role in regulating blood glucose, while insulin has a secondary role. Possibly, this is due to the fact that the rate of avian metabolism (particularly in passerines) demands a constant (high) supply of carbohydrate, regardless of physical activity and glucagon plays a major role in retrieving/converting potential fuel [31]. There was no clear statistical pattern regarding the amount of glucose level and the used cinnamon powder. A lot of researches has been carried out to induce hypoglycemic in chicks, but most of it has been unsuccessful. In this experiment the use of cinnamon powder as a hypoglycemic plant had no hypoglycemic effect on birds, either. Further studies are needed on the effect hypoglycemic plants on blood glucose, insulin and glucagon concentration in broilers.

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