

Evaluation the Effect of Dietary Calcium Percentage on Incidence of Gout Syndrome in Broiler Chicks

¹Adel Feizi and ²Mehrdad Nazeri

¹Department of Clinical Sciences, ²Young Researchers Club, Tabriz Branch, Islamic Azad University, Tabriz, Iran

Abstract: Gout syndrome is one of the common mortality causes accounted for poultry farms. Gout is diagnosed by deposition of urates in kidney, on heart serous surfaces, liver, mesenteric, air sac and peritoneum, etc. There are two types of diseases: visceral and joint gout. Incidence of gout syndrome in broiler chicks increases mortality and decreases performance. Gout causing factors could be classified in three sections; management and nutritional factors, infectious factors and toxic factors. The current study conducted to evaluate effect of dietary calcium percentage on incidence of gout syndrome and its effect on serum biochemical parameters in broiler chicks. Total 300 broiler chicks (Ross 308), divided in two groups; treatment and control. Each group has three replicates (50). All management factors including: light (intense and duration), temperature, vaccination program, ventilation rate, nutrition, stocking density for both groups were same but dietary calcium percentage was different. Dietary calcium for treatment group was 2 and 1% in control group. Blood samples of each group were collected on 5th, 35th and 42nd days and their serum separated by centrifuging followed by biochemical parameters were measured. Serum biochemical parameters are uric acid, urea, total protein, albumin, creatinine, calcium, phosphorus, magnesium, alkaline phosphatase. In addition, macroscopic examination of renal necropsy, diet exchange ratio, mortality percentage and their relationship were evaluated in this study. Results showed that in treatment group the rate of uric acid, urea, total protein, albumin, creatinine, calcium, calcium and alkaline phosphatase have meaningful changes compared control with group ($p < 0.05$). Evaluation of the serum level phosphorus in treatment group did reveal statistically significant decrease compared with control group ($p < 0.05$). There was no statistical meaningful change in serum level magnesium between two groups ($p > 0.05$). The FCR and mortality rate of treatment groups was higher than the control group. Deposition of urates in kidney, on heart serous surfaces, liver, mesenteric, air sac and peritoneum were displayed in treatment group. The urinary system of the treatment birds, in general, displayed inflammatory lesions showing abnormalities of color, size, shape and texture of kidneys and ureters. The ureters also showed occlusion and distention.

Key words: Serum biochemical parameters, gout, broiler chicks, kidneys, mortality, Iran

INTRODUCTION

Kidney is one of the vital organs with many functions in birds that affected by some disease and disorders; the most important of them is gout syndrome (Suryashe and Deshmukh, 1997). Gout is a disorder in which kidney's function decreases by numerous factors and results in deposition of calcium-sodium urate crystals in several sites, especially kidneys and viscera with increasing the rate of uric acid $> 10 \text{ mg dL}^{-1}$ (Saif, 2008; Patel *et al.*, 2007). Visceral gout diagnosed by deposition of urates in kidney, on heart serosal surfaces, liver, mesenteric, air sac and peritoneum or maybe formed in liver, spleen and other organs (Al-Ankari, 2006; Beckman, 2000). Joint gout is chronic form of the disease and has

low incidence. The disorder observed by deposition of urate around the foot joint is a singular condition and has no economical aspect (Saif, 2008; Guo *et al.*, 2005; Maxwell and Robertson, 1992). Different factors are involved in gout syndrome incidence like dietary and management factors, infectious factors and toxic factors; dietary factors, i.e., increasing of dietary calcium percentage rate has been discussed. Since, poultry dietary constituents have low calcium rate, some material like limestone and dicalcium phosphate are added as complements.

The excess of calcium is excreted by kidneys but adding too much calcium in dietary in a long period, causes kidney and parathyroid gland in young chicks and older poultry (Ismail, 1989). It must to note that the

standard rate of calcium in broiler chicks dietary is 1% and absorbable rate of phosphorous is 0.4% (Saif, 2008; Leeson and Summers, 2008). In a study, Ansar *et al.* (2004) fed the broiler chicks with different ratios of calcium-phosphorous 1:0/5, 2:0/5 and 3:0/5% from 1st-42nd days. They reported that the chicks fed by high calcium dietary (2 and 3%) revealed the increase of serum calcium concentration, decrease of serum phosphorous concentration, increase of the ratio of kidney's weight to total body weight and ureter dilation that caused by urate accumulation.

In a study conducted by Patel *et al.* (2007), the broiler chicks were fed by high calcium (1/7%) dietary from 1st day. They observed plasma uric acid triple the normal rate on 15th day also some plaster color urate deposition in viscera.

Ansar *et al.* (2004), Chang and Fun (1992) and Ougra (1981) observed decrease in serum phosphorous in broiler birds as a result of increasing dietary calcium. Considering some mistakes about dietary setting especially dietary calcium rate in poultry farms and its consequences like gout syndrome, this experimental study aimed at investigating the influences of double dietary calcium increase and its effect on some changes in serum biochemical rate, FCR, mortality percentage followed by incidence of gout syndrome in broiler chicks.

MATERIALS AND METHODS

In the current study, 300 Ross broiler chicks divided in two groups there were three replicates of 50 chicks. All breeding factors such as light, temperature, vaccination, ventilation, stock density and dietary were identical between two groups except the dietary calcium percentage; 2% for treatment group and 1% for control group. Serum samples were obtained from each replication on 5, 35, 42 and 10th days followed by separation of their serum by centrifuging in 3000 rpm for 15 min then the samples freezed in -19°C.

The relevant experiments then conducted for evaluating of uric acid, urea, total protein, albumin, creatinine, calcium, phosphorus, magnesium, alkaline

phosphatase; Ziestchem Co. (Iran) kits were used in all cases. Darman Kave Co. (Iran) kits were used in order to evaluating the rate of serum calcium and creatinine. The Spectrophotometer model Biowave made by UK was utilized for all samples. Production indices such as mortality rate, growth and FCR were examined in two groups. Further, two groups subjected to autopsy (necropsy) carefully for identifying of mortality causes. Consequently, raw data examined and analyzed by SPSS statistical software, Version 17 with t-test in meaningful level of $\alpha = 0.05$ and assurance level of 95%. Finally, the results mentioned as unmeaning, meaningful and much meaningful in $p > 0.05$, < 0.05 and < 0.01 , respectively.

RESULTS AND DISCUSSION

Table 1 shows the rates of serum uric acid in two understudying groups that examined 3 times. Statistical investigation of the rates of serum uric acid revealed no meaningful statistical difference between treatment and control groups on 5th day. However, increased level of uric acid is seen in treatment group compared with control group on 35th and 42nd days; this increase is meaningful compared with control group ($p < 0.05$).

Table 2 shows mortality percentage because of gout syndrome in treatment and control groups. Statistical analysis between two groups showed meaningful difference ($p < 0.05$). Also, total mortality percentage in treatment group showed meaningful increase that the difference between two groups is meaningful. FCR is shown in Table 2. Statistical analysis between two groups showed meaningful difference ($p < 0.05$) (Fig. 1 and 2). Like any other living creatures, in birds the kidneys health is necessary for fulfilling physiologic tasks of the body. Any factor which causes kidney's damage, leads to differences in kidneys' physiologic tasks and eventually causes some disorders in total physiology of the body. One the most important factors is gout syndrome (Suryashe and Deshmukh, 1997). What is important about incidence of gout syndrome is the percentage of dietary calcium which its standard rate for broiler chicks is 1% (Leeson and Summers, 2008).

Table 1: The rates of serum uric acid, urea, creatinine, total protein, albumin, calcium, phosphorus, magnesium, alkaline phosphatase in two understudying groups

Biochemical of actors day of blood sampling	Uric acid	Urea	Creatinine	Total protein	Albumin	Calcium	Phosphorus	Magnesium	Alkaline phosphatase
	-----mg dL ⁻¹ -----								
5th day of control group	4.61±0.15	11.72±0.11	0.38±0.01	3.72±0.07	1.020±0.03	9.34±0.11	4.04±0.05	2.59±0.06	372.46±6.97
5th day of treatment group	4.50±0.15	11.37±0.13	0.39±0.01	3.81±0.13	1.060±0.08	9.34±0.16	4.25±0.10	2.47±0.15	356.00±12.47
35th day of control group	5.02±0.08	21.17±0.07	0.46±0.01	3.87±0.08	1.060±0.06	10.72±0.08	4.33±0.10	4.01±0.06	583.26±10.05
35th day of treatment group	8.29±0.38*	18.23±0.47*	0.90±0.18*	58.00±0.08*	87.00±0.06*	2.04±0.27*	3.41±0.08*	3.88±0.06	761.91±13.57*
42nd day of control group	6.02±0.61	13.17±0.13	0.61±0.01	4.87±0.13	1.150±0.05	10.91±0.20	4.21±0.15	3.93±0.08	606.7±12.03
42nd day of treatment group	14.31±0.12*	21.17±0.19*	0.95±0.03*	6.23±0.19*	1.940±0.09*	13.20±0.14*	3.30±0.07*	3.68±0.09	876.67±11.80*

*The meaningful statistical difference compared with control group ($p < 0.05$)

Table 2: Comparative review of the broiler chicks' functions in two, control and treatment, groups

Experimental groups	Mortality percentage because of gout	Total mortality (%)	FCR
Treatment group	2.1 ^a	6.1 ^a	2.15 ^a
Control group	0.0 ^b	3.7 ^b	2.00 ^b

*Two different letters in a column show meaningful statistical difference between two groups ($p < 0.05$)



Fig. 1: Urates deposition and kidney lobules necrosis in broiler bird affected by gout (treatment group)

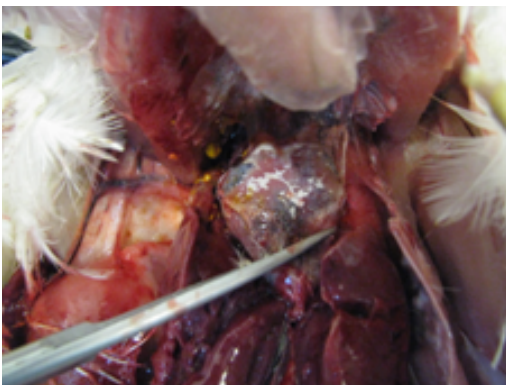


Fig. 2: Urates deposition on heart that is visible transparently (treatment group)

In the current study, complications resulted of double rate of calcium in broiler chicks' dietary was investigated. Kidneys' uric acid clearance is used as an important index in functional evaluations of kidneys. Therefore, the rate of uric acid in blood sample is one of the indices for health of kidney. Kimuara *et al.* (1991) reported the normal rate of uric acid 5.8 mg dL^{-1} which conforms to the findings in control group. Hence, in control group which were fed with standard rate of dietary calcium (1%), uric acid rate of blood sample varied between $4-8 \text{ mg dL}^{-1}$. However, in control group that were fed with 2% calcium, uric acid rate of blood sample was 2.5 times more than that of control group on 42nd day which revealed renal insufficiency.

Patel *et al.* (2007) fed the broilers with 1.7% calcium dietary; they observed also triple of normal rate in uric acid on day 15 and the plaster colored urates deposition in viscera. Their findings conform to the findings except the mortality that began in the study on day 35. Ansar *et al.* (2004) in a study fed the broiler chicks with high calcium (2 and 3%) and phosphorous (0.5%) dietary. The chicks fed by high calcium dietary revealed increase of serum calcium concentration, decrease of serum phosphorous concentration, increase of FCR and ureter dilation caused by urates accumulation. Their findings conform to the findings. The rate of serum calcium in most of birds is $8-18 \text{ mg dL}^{-1}$ (Chandra *et al.*, 1984) and in the study, this rate in control group is max. 10.91 and 13.20 mg dL^{-1} in treatment group that is meaningful, statistically ($p < 0.05$). The increase of serum calcium in treatment group is related to increase in dietary calcium. The increase of serum calcium and its decrease in the study conform to findings of Ansar *et al.* (2004), Wideman *et al.* (1983, 1989), Al-Ankari (2006) and Ismail (1989).

Normal rate of serum phosphorous is $2-4/5 \text{ mg dL}^{-1}$ (Kimuara *et al.*, 1991). In the study, also the rate of serum phosphorous in control group is 4.21 mg dL^{-1} on 42nd day and in treatment group is 3.30 mg dL^{-1} on 42nd day that the decrease of phosphorous is meaningful statistically, Ansar *et al.* (2004), Chang and Fun (1992) and Ougra (1981) observed the decrease of serum phosphorus with increasing of dietary calcium in broilers that conforms to the findings.

In present study, serum creatinine in treatment group was 0.90 and 0.95 mg dL^{-1} on 35th and 42nd days, respectively, however its rate in control group was 0.46 and 0.61 mg dL^{-1} on 35th and 42nd days, respectively. This increase is meaningful in treatment group, statistically ($p < 0.05$). The increase of creatinine level in treatment group because of the increase in dietary calcium conforms to Ansar *et al.* (2004), Wideman *et al.* (1983, 1989) and Wideman (1987). In the study, there was no meaningful difference about serum magnesium concentration between two groups ($p < 0.05$) that conforms with findings of Chandra *et al.* (1984). The rate of alkaline phosphatase has been increased in treatment group meaningfully in the current study ($p < 0.05$). About the relationship between renal insufficiency and the rate of alkaline phosphatase in birds, any data was not obtained from other researchers. The increase of serum urea in treatment group compared with control group was meaningful statistically ($p < 0.05$) however, there is no report herein from other researcher. The normal rate of total protein in poultry blood samples has been reported $3-5 \text{ g dL}^{-1}$ (Dein, 1986). In the study, the increase of total

protein and albumin in treatment group compared with control group was observed that was meaningful statistically ($p < 0.05$) and conforms to the findings of Beckman (2000). In the study, the FCR was 2 in control and 2.15 in treatment group which shows the increase of feeding in treatment group; these results conforms to findings of Ansar *et al.* (2004). The rate of mortality resulting from gout syndrome in treatment group was 2% more than control group; its rate calculated from 35th-42nd days. The rate of lameness and paralytic disability was 1 and 4.5% in control and treatment group, respectively however, there has been no report from other researchers.

Researchers began to necropsy by starting of clinical signs on 35th day and observed urates depositions around heart and necrosis in renal tissue which conforms to findings of Siller (1981) and Randall (1991).

CONCLUSION

The results of this study showed that 2% calcium in broilers' dietary increase the rate of serum uric acid, urea, total protein, albumin, creatinine, calcium, alkaline phosphatase that have meaningful difference compared with control group. The rate of phosphorous also in treatment group decreased meaningfully compared with control group. There was no meaningful difference between two groups about the rate of magnesium. Then, it can be observed that the physiologic process of kidneys encountered some disorders and consequently resulted in urates depositions on serous surfaces of viscera especially kidneys which are the symptoms of gout syndrome that makes vast mortality in herd. This phenomenon is very important economically so much attention must be given in setting the broilers' dietary especially the rate of dietary calcium for preventing of gout syndrome incidence and its consequences.

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