The effect of different levels of calcium and phosphorous on broiler performance

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Abstract

In order to study the different levels of calcium & phosphorous on bacterial population of small intestine and broiler performance, during 44 days (of age 12 to 56) with 4 different levels of calcium& phosphorous [to NRC (A) 10%, (B) 20%, (C) 30% (D) less than NRC] with 3 replicates, each replicate consisted 30 broilers of Ross strain. At the end of each week the level of blood calcium, the calcium & phosphorous & ash of tibia, membrane protein of duodenum & jejunum and feed conversion ratio was measured. The results of study revealed that the different levels of calcium and phosphorous of the diet had no significant effect on the blood calcium & phosphorous., and the phosphorous and ash of tibia, Group D and had lesser ($p < 0.05$) level of calcium of tibia.There was not any different between feed conversion ratio of all groups, in week 3, in group D, the least feed conversion, was observed ($p <0.05$). In week 4, group C had the least levels of feed conversion($p < 0.05$). In week 5 & 6 ,statistically there were no significant difference between the groups in feed conversion. In week I & 3, group A had the lowest & in week 2, group B had the highest levels of membrane protein of duodenum In week there were no difference between groups, & in week 5, group D &B had the lowest level of membrane protein of duodenum respectively.The highest and lowest level of membrane protein of jejunum in the first week, was observed in group A, and C, respectively, and there were no significant differences ($p < 0.05$) between groups through other weeks. The bacterial population of small intestine in group A and was higher throughout, the growing period. There were no statistic differences between them.

Key words: calcium, phosphorous and broil

Introduction

Calcium and Phosphorous are known as two vital minerals in nutrition of living existences. Physiological practices of these two elements in body are extensive. Some of them are making skeleton, transmission of neural messages, movement of muscles, action of enzymes and coagulation of blood (1&3).Animal breeding to increase production and growth rate, results in increasing in usage of calcium and phosphorous. Applying mineral sources, extensively to supply these ingredients, causes disorder in physiologic process of digestion. This disorder can impress on digestion and absorption of food, for example making free structures of salts, like carbonates, results in differences in PH of intestine and therefore incomplete digestion and absorption of food, variation in natural microflour of intestine and change in amount of absorption of intestine (10). On the other hand, in usage of supplementary calcium for animal farm, it is necessary to consider to calcium and phosphorous of diet. False rate may be as harmful as lack of these elements (1). One

of the important sources for calcium is carbonate calcium which has 2.5 part carbonate and structure of carbonate can be effective in PH of digestive system. On the other hand, digestion and absorption of calcium should take place in an acidic environment. Usage of fish meal in diet and increasing acidity of intestine result in variations in natural microflour of intestine, especially for broiler chicks. Growth of clostridium perfingens and coccidial factors are two side-effects which result in antrit of intestine. In healthy poultry, bacterial population in intestine are generally composed of lactobacilli and streptococcal . In the time of PH changes microbic population of intestine will be affected. This research studies the different levels of calcium and phosphorous on bactorial population, PH of intestine and the performance of broiler chicks in a complete randomize design in a bringing up career. To analyze data Sigma Stat Software and Statistical test of Dunnet are applied.

Materials and Methods:

The race of broiler chicks was ROSS. All of them were brought up in the same conditions until the first week of age. After that three hundreds and sixty chicks were selected haphazardly. They were weighted and the average weight was determined. Then they were kept in twelve cages. The food was produced every four days. In the end of every week, the reminded food every cage was weighted by pointer scale (with 10gr precision) and recorded. The used food of every chick was determined. The used diet by chicks was produced based on NRC tables (1994). Four groups with three repetitions are studied. The first group was the control group which used usual diet (based on NRC table) without reducing di calcium phosphate and shell. In the second group, 10% of di calcium phosphate of diet was decreased. The reducing of di calcium phosphate was 20% and 30% for the third and forth group respectively. In the end of every week the reminded food of every chick was weighted and recorded. The average weight of chicks was determined by weighting all chicks and dividing by number of chicks. The mean of used food, added weight and feed conversion coefficient were computed. Lowery's method was applied to measure protein of membrane of intestine. Calcium and phosphorous of blood and legs were measured in two stages by standard gates.

To determine microbic load of intestine and microflour change in the experiment, produced samples of intestine contains and cecum were counted and determined with four plate test. In this general purpose forms, intestine and lactobacilli are counted in standard environment. Whereas there were four different levels of calcium and phosphorous in the diet of chicks and the way that units located, this research is designed based on a complete random with four level and three repetitions. The recorded data from studied factors was classified by excel software and analyzed based on a complete random plot. Dunnet'test was applied to compare averages and all data was computed by linear model GLM and statistical software Sigma Stat in the level of 5% ($p<0.05$).

Results and Discussion

Different percents of calcium and phosphorous of diet were not related to dry substance and phosphorous of legs of under studied chicks and these results were like what have been gained by Skinner and et al, Holcombe and et al, Tortora and et al. Different percents of calcium and phosphorous of diet affect on calcium of legs significantly($p<0.05$)(4&15). The group, which received 30% calcium and phosphorous less than NRC, shows significant difference with other groups. Almost 99% of total calcium exists in skeletons and teeth. By reducing calcium and phosphorous of diet and setting acidic conditions in mucous of intestine, the absorption of calcium and phosphorous increases, on the other hand based on the Hurwitz and et al's research reducing calcium and phosphorous of diet results in increasing of concentration of vitamin D five times and more absorption of calcium from mucous of intestine(5). When the calcium of blood decreases from 6 miligramme in deciliter, paratormone hormone motivates the transfer of calcium and phosphorous from skeleton to blood and on the other way by impression on kidneys results in producing vitamin D and cholecalciferol (vitamin D_3) affects from small intestine and in this way calcium absorption increases. The effects of reducing calcium and phosphorous of diet on calcium of blood is shown in table 1.

Table 1: The effect of reducing calcium and phosphorous on average of calcium of blood in different weeks.

Treatment	First week	Second week	Third week	Fourth week	Fifth week
Calcium&phosphorous based on NRC	12.43	10	9.4	11.63	10.8
Calcium&phosphorous 10% less than NRC	11.5	11.63	9.33	11.7	10.98
Calcium&phosphorous 20% less than NRC	10.6	8.27	9.23	12.83	13.07
Calcium&phosphorous 30% less than NRC	12.65	8.15	9.67	13.7	9.87

Different levels of calcium and phosphorous of diet have no significant impression on calcium of blood and this is in contrary with what has been reported by Ruschkowski-Hart(11) and Frost-Roland(3). They reported reduction in calcium of blood by reduction calcium of diet. Effective factors in absorption of calcium are acid of intestine, calcium concentration in intestine and vitamin D. Most of calcium in the entrance of intestine absorbs before the acid of stomach neutralizes completely(PH=2 to 7). Parathormone hormones, Calcitonine and vitamin D are basic regulators of calcium metabolism. Parathormone motivates the transfer of calcium and phosphorous from bone to blood and by affecting on kidneys the absorption of calcium and repel of phosphorous increase. The second effect of Parathormone, on kidney from small intestine, motivates the production of vitamin D and in this way the absorption of calcium increases. Birds produce Calcitonine in Ultimbranchial glands and in hypoclismic birds, concentration of calcium in serum of blood can be reduced. Hypoclasmic shock in parrots family because of repel of protein from pension (kidney illness), which results in hypoalbomini, has been reported. In intestine, acidophil bacteria (lactobacillus) results in increasing in absorption

of calcium. By decreasing calcium and phosphorous of diet, PH of intestine reduces and on the other side the reduction of PH results in increasing of acidophil bacteria and decreasing pathogen bacteria. In rat, the reduction of calcium and phosphorous of diet results in increasing in concentration of vitamin D five times. inferred that the effect of parathyroid hormone results in producing phosphorous in kidney, this reduces the phosphate of kidneys which motivates kidneys to produce vitamin D.
In the first and second week of the experiment (12-28 days) decrease of calcium and phosphorous of diet have no significant effect on feed conversion. In the third week(28-38 days), the fourth group (30% less than NRC) in comparison with other groups(NRC, 10% less than NRC and 20% less than NRC) had significant statistical difference ($p<0.05$). The lowest feed conversion belongs to the fourth group. Other groups haven't significant statistical difference with each other. In the fourth week (35-42 days), second group (10% less than NRC) in comparison with the first group(based on NRC) and fourth group (30 % less than NRC) didn't have significant statistical difference ($p<0.05$) but the third group (20% less than NRC) had no significant statistical difference with other groups. In the fourth week the lowest feed conversion assigned to the second group. In the fifth and sixth week (49-56 days) , no significant statistical difference was observed between groups and this emphasized on what were found by Skinner and et al(13) Kim (12)compared feeding by lactobacillus and viginiamycin in broilers and found out that feeding by lactobacillus improves absorption of feed and sometimes feed conversion. Ferd and et al(3) believed in that by increasing the number of lactobacillus in intestine, the absorption improves and in general feed conversion increases. By reducing PH of intestine results in increasing the number of lactobacillus, the length of villi and decreasing the thickness of intestine. All of them result in improving feed absorption and conversion.
How different percents of calcium and phosphorous in diet affect on protein membrane of duodenum and jejunum are shown in tables 3 and 4.

Table 2: The effect of calcium and phosphorous on feed conversion of different weeks.

Treatment	First Week (12-19)	Second Week (19-28)	Third Week (28-35)	Fourth Week (35-42)	Fifth Week (42-49)	Six Week (49-56)	1-6 Week (12-56)
Calcium&phosphorous based on NRC	2.43	2.23	1.90	2.76	2.39	2.68	2.39
Calcium&phosphorous 10% less than NRC	2.33	2.22	2.17	2.61	2.43	2.78	2.33
Calcium&phosphorous 20% less than NRC	2.47	2.19	2.06	2.67	2.30	2.53	2.33
Calcium&phosphorous 30% less than NRC	2.50	2.22	1.66	2.8	2.41	2.68	2.35

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Table 3. The impression of different levels of calcium and phosphorous on the protein of membrane duodenum in broilers.

Treatment	First Week (12-19)	Second Week (19-28)	Third Week (28-35)	Fourth Week (35-42)	Fifth Week (42-49)
Calcium&phosphorous based on NRC	4084[a]	8047[a]	4000 [a]	6842[a]	7388[a]
Calcium&phosphorous 10% less than NRC	7624[a]	4466[a]	7816[a]	6646[a]	4550[a]
Calcium&phosphorous 20% less than NRC	8095[a]	7066[a]	8000[a]	7500[a]	6060[a]
Calcium&phosphorous 30% less than NRC	7541[a]	8246[a]	7196[a]	7473[a]	4000[a]

In the first week, the group fed based on NRC had significant statistical difference ($p<0.05$) with other groups. The group fed based on NRC had the least protein of membrane duodenum in comparison with other groups. In the second week, the group fed 10% less than NRC had significant statistical difference ($p<0.05$) with other groups and it had the least protein of membrane duodenum. In the third week, the group fed based on NRC had the least protein of membrane duodenum and significant statistical difference($p<0.05$). In the fourth week, no significant difference between group was observed. In the fifth week, the group fed based on NRC, 20% less than NRC, 10% less than NRC and 30% less than NRC had significant statistical difference and respectively had the lowest level of protein in membrane duodenum.
In the first week, the group fed based on NRC and 30% less than NRC had significant statistical difference with other groups($p<0.05$). The most protein of membrane jejunum belonged to the first group and the least belonged to the third group. In other weeks, no significant difference between groups was observed about protein of membrane jejunum

Table 4. The impression of different levels of calcium and phosphorous on the protein of membrane jejunum in broilers

Treatment	First Week (12-19)	Second Week (19-28)	Third Week (28-35)	Fourth Week (35-42)	Fifth Week (42-49)
Calcium&phosphorous based on NRC	9645[a]	8036[a]	8043 [a]	7572[a]	7740[a]
Calcium&phosphorous 10% less than NRC	8000[a]	8041[a]	7982[a]	7986[a]	7460[a]
Calcium&phosphorous 20% less than NRC	7862[a]	7853[a]	8000[a]	7986[a]	7460[a]
Calcium&phosphorous 30% less than NRC	8249[a]	8407[a]	8407[a]	7979[a]	7170[a]

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