

Effects of different calcium levels on broiler performance and tibia bone parameters

RAMAZAN DEMIREL, MURAT SEDAT BARAN*, TANAY BILAL**, UĞUR ÇEVİRİM***

Faculty of Agriculture, Department of Animal Science, *Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutrition Diseases, Dicle University, 21280, Diyarbakır/Turkey

**Faculty of Veterinary Medicine, Department of Animal Nutrition and Nutrition Diseases, Istanbul University/Turkey

***Ministry of Agriculture and Rural Affairs, Diyarbakır 21100/Turkey

Demirel R., Baran M. S., Bilal T., Çevrim U.

Effects of different calcium levels on broiler performance and tibia bone parameters

Summary

The aim of this research was to investigate the addition of Calcium source (marble powder) of up to 1.2, 1.4, 1.6% levels on growth performance, feed intake, some organ weights and tibia ash parameters in broiler diets. This research was conducted according to Randomized Plots Design by using 3 groups with 3 replicates between 12 May - 23 June in Çarıklı region of Diyarbakır. The experiment was conducted on 126 day-old equally sexed Ross 308 broiler chicks. Three diets used as 3 treatments were included (1.2, 1.4 and 1.6% Ca levels) in broiler the diets. Three replicates with 14 equally sexed birds were arranged in each plot. The experiment was started from 7-days-of-age to slaughter weight. The first group was a control and contained 1.2% Ca levels; marble flour was added to the control diet as a Ca source and the Ca levels 1.4 and 1.6% for the 2nd and 3rd groups, respectively. At the end of the trial, data were analysed by MSTAT C program, and means were examined by DUNCAN's multiple test. There were no statistically significant differences between the groups for all investigated parameters (Live weight gain, feed intake, feed conversion ratio, carcass parameters and some organ weights) using Ca doses ($P > 0.05$). However, crude ash and calcium contents of diets were increased by additional Ca levels ($P < 0.01$), but phosphorus content of diets were decreased by the addition of a calcium source. The results of this study have shown that there is no adverse effect on broiler performance of an additional Ca source up to 1.6% levels.

Keywords: calcium, broilers, weight gain, feed conversion

Calcium is a major element in broiler nutrition. In growing period of broilers, higher Ca level is required than in other periods. Also, Ca has an important role in the formation of bone and teeth structures and in bone mineralisation determining mechanical resistance of skeleton. In order to increase efficiency of Ca absorption, vitamin D is usually added to broiler diets. Ca is important for bone development, blood-clot formation, muscle contraction and to provide good eggshell quality.

Scheideler et al. (10) reported that there were no effects of dietary Ca and P levels on live weight gain, feed efficiency, bone ash and legs problems, but in certain weeks of age, increased mortality was observed and only at the third week of life, increased bone ash Ca level was stated.

Qian et al. (8) noted that addition of D_3 in maize-soybean meal diets indicated a potential improvement through utilization of P and Ca by increasing Ca and P retention about 5 to 12% in birds, leading to an in-

crease in toe ash content P without added phytase. These results suggested that phytase, D_3 , Ca and total P are important factors together with utilisation of phytate P and Ca in broilers.

Mohamed (6) noted that using non phytate P at the level of 0.30% in starter and grower diets decreased tibia ash content, live weight gain and feed conversion ratio. Pintar et al. (7) reported that increasing levels of calcium with phytase supplementation to diets based on different cereals had a significant effect on calcium content of tibia in broiler diets. Numerous studies showed that tibia ash content increased with phytase addition when broilers were fed with maize-soybean based diets, as reported by Qian et al. (8), Sohail and Roland (11). On the contrary, Zyla et al. (13), in the broilers fed with wheat-soybean based diets, demonstrated that tibia ash content did not increase when phytase was added. As stated before, data for the tibia mineral content are contradictory. Some authors found variation in mineral content in the whole tibia

(11). Karamüftüoğlu and Kocabağlı (5) found that live weights of broilers which were fed low Ca level were higher than high Ca levels.

Rossi et al. (9) reported that tibial ash content was significantly lower with diets low in Ca and P or low in cholecalciferol. Diets low in cholecalciferol increased the severity of tibial TD and reduced body weight.

The aim of this research was to investigate the effect of additional Ca source (marble powder) up to 1.2, 1.4, 1.6% levels on growth performance, feed intake, some organ weights and tibia ash parameters in broiler diets.

Material and methods

Unsexed 126 day old Ross-308 broiler mix chicks (equal sex) were placed in 9 pens and fed on the same starter diet as *ad libitum* until 7 days of age. The trial was started from the beginning of the second week by using different Ca levels in diets. In each pen (replicate), a total of 14 chicks were grown: 7 male and 7 female. The trial lasted from one week of age to slaughter time. Live weight gain (LWG), feed intake (FI), feed conversion ratio (FCR) were measured as well. At the end of the experiment, 2 birds (male + female) in each replicate, totally 18 were selected randomly and slaughtered. In order to determine cold carcass and organ weights, birds were kept at +4°C for 24 hours. Starter diet contained 23% crude protein and 3250 kcal/kg ME. Grower and finisher diets had similar crude protein (22%) and energy 3185 kcal/kg ME contents. Marble powder was used as Ca source. According to groups, total Ca levels were 1.2, 1.4 and 1.6%, respectively. In order to increase Ca availability, vitamin D (2000 IU/kg feed) were added to each diet. The first group (control) was not supplemented by marble powder.

Diet contents were analyzed according to Weender Analysing Method (1). Feed conversion values, total live weight gains and feed consumption values were calculated weekly. Crude ash values were obtained and used to determine Ca and P contents according to AOAC procedure (2). Statistical analysis was used in randomized plots design with three replicates and data were analysed by MSTAT C programme (4), while means were examined by Duncan's multiple test (3).

Tab. 1. Weekly and total live weight gain (LWG), feed intake (FI) and feed conversion ratio's (FCR) means in control and experimental groups of broilers

Weeks	Groups								
	I			II			III		
	LWG (g)	FI (g)	FCR	LWG (g)	FI (g)	FCR	LWG (g)	FI (g)	FCR
1	72.73 ± 3.806	119.16 ± 2.488	1.65 ± 0.127	78.53 ± 1.820	123.44 ± 4.320	1.57 ± 0.032	76.46 ± 3.137	118.67 ± 2.862	1.56 ± 0.084
2	170.64 ± 3.557	296.32 ± 6.462	1.74 ± 0.055	184.78 ± 19.241	317.14 ± 8.017	1.75 ± 0.153	163.86 ± 8.039	264.80 ± 16.216	1.82 ± 0.163
3	334.17 ± 7.158	504.07 ± 17.306	1.51 ± 0.084	354.40 ± 13.700	521.87 ± 15.231	1.47 ± 0.035	322.14 ± 9.288	447.19 ± 9.366	1.48 ± 0.026
4	447.35 ± 6.749	622.76 ± 25.333	1.39 ± 0.074	325.16 ± 78.609	608.68 ± 8.553	2.20 ± 0.695	449.09 ± 46.837	700.37 ± 1.337	1.59 ± 0.157
5	286.48 ± 40.655	779.11 ± 25.052	2.83 ± 0.402	493.90 ± 102.01	812.72 ± 34.269	1.75 ± 0.252	341.17 ± 18.932	843.79 ± 21.527	2.48 ± 0.099
6	321.94 ± 23.045	752.99 ± 17.687	2.36 ± 0.157	254.12 ± 39.724	785.05 ± 11.685	3.25 ± 0.507	350.91 ± 22.128	856.90 ± 44.457	2.45 ± 0.043
Total	1633.31 ± 12.858	3074.40 ± 59.736	1.88 ± 0.037	1690.89 ± 34.078	3168.90 ± 36.708	1.87 ± 0.035	1703.63 ± 33.835	3291.72 ± 29.263	1.93 ± 0.026

Results and discussion

Weekly and total live weight gain, feed intake and feed conversion ratio value means and their variance analysis results are given in tab. 1. There were no statistically significant differences among groups for weekly and total live weight gain, feed intake and feed conversion ratio ($p > 0.05$). Total live weight gain values ranged from 1633.31 g to 1703.63 g with the highest live weight gain obtained in group III, followed by II and I group. Total feed intake values varied from 3074.40 g to 3291.72 g. As a result, live weight

Tab. 2. Means of warm-cold carcass and organ weights (g) and dressing percentages (%) and tibia ash parameters in control and experimental groups

Parameters	Groups		
	I	II	III
Warm carcass weights	1399 ± 61.879	1340 ± 100.957	1340 ± 93.798
Cold carcass weights	1383 ± 60.151	1328 ± 100.381	1324 ± 93.054
Warm dressing percent	74.37 ± 2.237	72.48 ± 1.553	72.53 ± 0.633
Cold dressing percent	73.51 ± 2.154	71.83 ± 1.551	71.69 ± 0.653
Liver	49.03 ± 4.260	40.21 ± 2.445	46.34 ± 3.416
Heart	7.01 ± 0.110	7.33 ± 0.278	6.91 ± 0.244
Full gizzard	34.24 ± 3.137	35.97 ± 2.549	31.69 ± 4.184
Empty gizzard	26.50 ± 1.322	29.04 ± 1.298	26.49 ± 1.763
Bursa Fabricius	0.986 ± 0.200	0.866 ± 0.049	1.206 ± 0.099
Adrenary gland	0.173 ± 0.018	0.180 ± 0.010	0.176 ± 0.019
Tibia crude ash	10.422 ± 0.154 ^a	11.253 ± 0.108 ^b	12.347 ± 0.135 ^c
Tibia calcium	16.795 ± 0.146 ^a	17.590 ± 0.099 ^b	17.752 ± 0.076 ^b
Tibia phosphorus	8.555 ± 0.078 ^a	8.163 ± 0.094 ^b	6.617 ± 0.088 ^c

Explanation: a, b, c – means in the same line with different superscript letters are different significantly at $p \leq 0.01$

gain values were not affected positively or negatively by addition of Ca up to 1.6% level ($p > 0.05$). These results are consistent with those by Scheideler et al. (10), but higher than the findings of Karamüftüoğlu et al. (5). The highest feed intake value was obtained in group III (3291.72 g), followed by group II (3168.90 g) and control (3074.40 g) respectively. The results obtained from feed consumption are consistent with those reported by other authors (11, 13). The highest total feed conversion ratio was obtained in group III (1.93), followed by group I (1.88) and II (1.87), respectively. As a result, addition of Ca did not affect total feed conversion ratio. This result is also consistent with other results (10).

Mean values of warm-cold carcass weights and dressing percentages, liver, heart, full – empty gizzard, bursa Fabricius and adrenary gland weight and tibia ash parameters of broilers with their analysis of variance values are presented in tab. 2. According to the results of variance analysis, there were no statistically significant differences among groups for warm-cold carcass weights, dressing percentages and organ weights (liver, heart, full – empty gizzard, bursa Fabricius and adrenary gland). However, there were statistically significant differences for tibia bone ash, calcium and phosphorus contents ($p < 0.01$). The highest warm carcass weight was obtained in control group (1399 g), followed by group II (1340 g) and group III (1340 g). Considering warm dressing percentage, the highest value was in control group (74.37%), and similar in group III (72.53%) and group II (72.48%). For cold carcass weight and dressing percentages, the highest values were found in control group (1383 g – 73.51%). Ca levels higher than 1.2% did not affect significantly cold carcass weight and dressing percentages.

The highest organ weight was obtained in liver of control group (49.03 g); heart (7.33 g), full–empty gizzard (35.97–29.04 g) in group II and bursa Fabricius and adrenary gland (1.206, 0.180 g) in group III. There were no statistically significant differences in organ weight. These results are consistent with those found by other authors (9), but different from the results obtained at the age of broilers at 3 weeks of age (10).

The highest tibia bone ash value was obtained in group III (12.347%), followed by group II (11.253%) and control group (10.422%). For tibia Ca level, the highest value was obtained in group III (17.752%), II and control group, respectively. According to the results of Duncan test, control group was significantly different from groups II and III. However, there was no significant difference between groups II and III. The highest phosphorus value was obtained in control group (8.555%), followed by groups II and III. The results obtained showed that there were important differences among groups.

Conclusion

As a result, it can be suggested that additional calcium may be used up to 1.6% in the form of marble powder in diets without decreasing broiler's performance.

References

1. *Akyıldız A. R.*: Laboratory Guide of Feed Knowledge. Ankara University, Faculty of Agriculture Publishing. No: 358. Applying Guide: 122. Ankara 1968.
2. *Anon.*: Official Methods of Analysis, 9th ed., Association of Official Agricultural Chemist, Washington, D.C. 1984.
3. *Duncan D. B.*: Multiple Range and Multiple F Tests. *Biometrics* 1955, 11, 1-42.
4. *Düzgüneş O.*: Statistical Methods-I. Lecture Book, Ankara University, Faculty of Agricultura Publishing. No: 862. Ankara 1983.
5. *Karamüftüoğlu S., N. Kocabağlı.*: Effect of Various Calcium Levels and Anionic Salts on Blood Acid-Base Balance, Growth Performance and Development of Tibial Dyscondroplasia in Broilers. *Turk. J. of Vet. Anim. Sci.* 2001, 25, 7-14.
6. *Mohamed M. A.*: Effect of Reducing Calcium and Supplemented Phosphorus Levels on Performance and Bone Parameters of Chicks. *Egypt. Poultry Sci. J.* 1998, 18, 47-60.
7. *Pintar J., Bujan M., Homen B., Gazic K., Sikiric M., Cerny T.*: Effect of Supplemental Phytase on the Mineral Content in Tibia of Broilers Fed Different Cereal Based Diets. *Czech J. Anim. Sci.* 2005, 50, 68-73.
8. *Qian H., Kornegay E. T., Denbow D. M.*: Utilization of Phytate Phosphorus and Calcium as Influenced by Microbial Phytase, Cholecalciferol, and the Calcium Total Phosphorus Ratio in Broiler Diets. *Poultry Sci.* 1997, 76, 37-46.
9. *Rossi A. F., Butcher G. D., Miles R. D.*: The interaction of Boron with Calcium, Phosphorus and Cholecalciferol in Broilers. *J. Appl. Anim. Res.* 1994, 6, 151-160.
10. *Scheideler S. E., Rives D. V., Garlich J. D., Ferket P. R.*: Dietary Calcium and Phosphorus Effects on Broiler Performance and the Incidence of Sudden Death Syndrome Mortality. *Poult. Sci.* 1995, 74, 2011-2018.
11. *Sohail S. S., Roland D. A.*: Influence of Supplemental Phytase on Performance of Broilers Four to Six Weeks of Age. *Poultry Sci.* 1999, 78, 550-555.
12. *Şenel H. S.*: Interrelationship and Effect of Calcium and Vitamin D on Growth, Feed Efficiency and Bone Ash of Weanling Rats. *The Journal of Veterinary Faculty, Ankara University* 1968, 15, No: 1.
13. *Zyla K., Koreleski J., Swiatkiewicz S., Wikiera A., Kujawski M., Piironen J., Ledoux D. R.*: Effect of Phospholytic and Cell Wall-Degreding Enzymes on the Performance of Growing Boilers Fed Wheat-Based Diets Containing Different Calcium Levels. *Poultry Sci.* 2000, 79, 66-76.

Author's address: Dr. Ramazan Demirel (PhD), Feeds and Animal Nutrition Department of Animal Science, Faculty of Agricultura, Dicle University, 21280 Diyarbakır/Turkey; e-mail: ramazand@dicle.edu.tr