

Performance, Gait Score and Calcium and Phosphorus Retention at Different Levels of Calcium and Phosphorus in Broiler Diets

S. Steinfeldt^{1}, P. Sørensen², and B.L. Nielsen¹, ¹Dept. Animal Health, Welfare and Nutrition, ²Dept. Genetics and Biotechnology, Danish Institute of Animal Sciences, DK-8830 Tjele, P.O. BOX 50, Denmark. E-mail: Sanna.Steenfeldt@agrsci.dk*

Abstract

In an experiment with male broilers, the effect of different levels of dietary calcium and phosphorus on performance, gait score, and foot-pad dermatitis in addition to Ca and P retention were studied. Phytase (RONOZYME P) was added to all diets, and increasing amounts of whole wheat was fed together with pellets. No significant differences were found in performance or gait score, and both incidence and severity of foot-pad dermatitis were low. Ca and P retention was significantly affected by treatments at 21 days and was highest with the lowest content of dietary Ca and total P. In the present study, it was possible to decrease the level of Ca and total P to 5.8 and 4.6g/kg feed (pelleted feed plus wheat) in grower diets without negative effects on performance and with improved Ca and P retention. It is assumed that phytase has increased the availability of both Ca and P.

Introduction

The phosphorus (P) contained in cereals and soybean meal, which are the main ingredients in broiler diets, is to a large extent present as phytate bound P. As P in this form is poorly available for poultry it is necessary to supplement broiler diets with sources of inorganic P in order to cover their requirement for P. Due to the low availability of phytate bound P, a high amount of P is excreted in poultry manure, which is used as fertilisers on cultivated fields. Excess of P has created an environmental problem in many countries, and especially wetland areas are highly sensitive to leaching of nutrients from the surrounding land. It is therefore important to reduce the content of P excreted from poultry, without affecting the welfare and performance of the birds. Improving the availability of phytate bound P by application of microbial phytase to broiler diets has been demonstrated in recent years (Simons et al., 1990). Since Calcium (Ca) and P are closely associated in many biological functions, particularly in bone formation, it is important to consider the dietary level of Ca when total P content is reduced. It has been found that phytase in addition to increased body weight gain and P retention also improved Ca retention, however increasing the Ca:total P ratio had negative effects on the measured parameters (Qian et al. 1997). The aim of the present study was to examine the effects of different levels of Ca and total P on performance, gait score, and foot-pad dermatitis in addition to Ca and P retention in broiler chickens.

Materials and Methods

Four experimental diets (A, B, C, D) differing with respect to their level of Ca and total P were fed ad libitum to male broiler chickens from 0-6 weeks of age. The diets were fed as pellets together with increasing amounts of whole wheat added after the first week (5, 10, 20, 25, and 30% whole wheat in weeks 2-6, respectively). The diets were formulated to contain the recommended levels of other nutrients (e.g. protein, amino acids, energy) taking into account the increasing amount of whole wheat. The inorganic P source used was mono-calcium-phosphate. The same starter diet was given to all groups during the first week (calculated content: Ca=9g/kg feed, total P=7.0g/kg feed), whereas the content of Ca and P was decreased gradually after the first week (Table 1).

Table 1. Calculated content of calcium and total phosphorous in grower/finisher diets (g/kg)

	Grower 1 (7-14 days)				Grower 2* (14-35 days)/ Finisher (35-42 days)			
	A	B	C	D	A	B	C	D
<u>Pelleted feed:</u>								
Calcium	8.5	8.5	7.8	7.8	8.2	8.2	7.0	7.0
Phosphorus	6.5	6.0	6.0	5.5	6.2	5.5	5.5	5.0
<u>Total feed: pelleted feed + whole wheat:</u>								
Calcium	8.1	8.1	7.4	7.4	6.7/5.8	6.7/5.8	5.8/4.9	5.8/4.9
Phosphorus	6.3	5.8	5.8	5.4	5.6/5.2	5.0/4.7	5.0/4.7	4.6/4.2

*Average values from week 3, 4 and 5.

The finisher diets (35-42 days) were similar to the grower 2 diets with respect to Ca and total P in the pelleted feed. However, addition of whole wheat lowered the content in the total feed (Table 1). Phytase (RONOZYME P, DSM Nutritional Products) was added to all diets in table 1 (calculated to be 750 FYT/kg total feed). 336 male broilers (Ross 308) were allocated in 16 floor pens (21 chickens per pen), and four replicates per treatment. The lighting programme followed current legislated practice in Denmark (hours of darkness per 24 hours: 0h on days 0-3; 1h on days 3-5; 8h on days 5-13; 4.5h on days 13-29; and 1.5h on days 29-42). Chickens and feed were weighed each week and the registrations were obtained per floor pen. Excreta were collected quantitatively each week, where an equal number of chickens from each pen were placed in special three-tier batteries used for collection of excreta. The chickens were offered the same experimental diets as those in their floor pens, to where the chickens were moved back after collection. The diets, wheat, and excreta samples were analysed for content of dry matter, calcium, and phosphorus. Walking ability was scored on chickens at 35 days, using the method by Kestin et al. (1992). The incidence and severity of foot-pad dermatitis were registered on all the birds slaughtered at the abattoir. On average 18 birds per pen were assessed for foot-pad dermatitis. The left foot of each bird was scored for signs of foot-pad dermatitis using the 3-point scale with 0 given to feet with no foot-pad dermatitis, 1 to mild, and 2 to feet with severe foot-pad dermatitis (Ekstrand et al., 1997).

Results and Discussion

The chemical analyses of Ca and total P in the experimental diets and wheat showed values (not shown) close to the calculated values, except for the finisher diet, where the Ca in diet A and B was lower than expected. No significant differences were found in performance parameters or gait score (Table 2). Weight gain of broilers fed with diet A was slightly higher than for the other groups in the first weeks. The same tendency was seen with feed conversion. However, the differences were not significant and the performance data obtained for the whole period of 6 weeks showed that the lower content of Ca and P, especially in diet C and D, did not have any negative influence on performance in the present experiment, indicating that the level of Ca and P was sufficient to cover the chickens requirement for these minerals. The performance results were reflected in the gait scores with no significant difference between treatments. The overall mean gait score was 2.2 (S.D. \pm 0.5). Both incidence and severity of foot pad dermatitis were very low (overall mean % of birds affected: 0.11 (S.D. \pm 0.099); mean foot-pad score: 0.11 (S.D. \pm 0.106), and neither were sufficiently high to reveal any effects of treatments. Mortality was low in all groups (average 1%). Ca and P retention was significantly affected by treatment at 3 weeks of age (Table 2). The Ca and P retention was highest in broilers fed diets C and D with the lowest content of Ca, and

the lowest total P in diet D. At 6 weeks of age, there were no significant differences between treatments and retention was generally decreased. Qian et al. (1997) found that dietary Ca:total P ratios should be in the range between 1.1:1 to 1.4:1 in order to achieve an efficient use of phytase. Increasing the ratio influenced performance and Ca and P retention negatively. It can be concluded from the present study that it is possible to decrease the level of Ca and total P in broiler grower diets to those of diet D without negative effects on performance parameters and with an improved P retention compared to diet A and B. It is assumed that the added phytase has increased the availability of both Ca and P.

Table 2. Effect of experimental diets on performance parameters, Ca and P retention

	Diet A	Diet B	Diet C	Diet D	SEM
<u>Days 7-14:</u>					
Weight gain (g)	295	292	278	286	2.71
Feed intake (g/bird)	370	373	356	368	3.76
Feed conversion (g/g)	1.25	1.28	1.28	1.29	0.01
<u>Days 21-35:</u>					
Weight gain (g)	1875	1840	1827	1812	15.61
Feed intake (g/bird)	3067	3085	3019	3006	26.88
Feed conversion (g/g)	1.64	1.68	1.65	1.66	0.01
<u>Days 0-42:</u>					
Weight gain (g)	2784	2752	2711	2787	20.90
Feed intake (g/bird)	4831	4847	4757	4789	35.78
Feed conversion (g/g)	1.74	1.76	1.75	1.72	0.01
<u>Gait score (%):</u>					
1	9	5	10	2	1.21
2	69	73	65	76	2.29
3	22	22	25	22	2.07
<u>Ca retention (%):</u>					
Age 3 weeks	60 ^{ab}	56 ^b	62 ^{ab}	66 ^a	1.27
Age 6 weeks	53	57	60	54	1.70
<u>P retention (%):</u>					
Age 3 weeks	59 ^{ab}	58 ^b	61 ^{ab}	64 ^a	0.91
Age 6 weeks	47	52	56	51	2.47

Means within columns with different letters are significantly different (P<0.05)

References

- EKSTRAND, C, AGERS, B. and SVEDBERG, J.** (1997) Rearing conditions and foot-pad dermatitis in Swedish broiler chickens. *Preventive Veterinary Medicine*, **31**: 167-174.
- KESTIN, S.C., KNOWLES, T.G., TINCH, A.E. and GREGORY, N.G.** (1992) Prevalence of leg weakness in broiler chickens and its relationships with genotype. *Veterinary Record*. **131**: 190-194.
- SIMONS, P.C.M., VERSTEEGH, H.A.J., JONGBLOED, A.W., KEMME, P.A., SLUMP, P., BOS, K.D., WOLTERS, M.G.E., BEUDEKER, R.F. and VERSCHOOR, G.J.** (1990) Improvement of phosphorus availability by microbial phytase in broilerw and pigs. *British Journal of Nutrition*. **64**: 525-540.
- QIAN, H., KORNEGAY, E.T. and DENBOW, D.M.** (1997) Utilization of phytate phosphorus and calcium as influenced by microbial phytase, cholecalciferol, and the calcium:total phosphorous ratio in broiler diets. *Poultry Science*. **76**: 37-46.