Relationship of electrolyte balance and dietary calcium and phosphorus content to chicken performance

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Calcium (Ca) and phosphorus (P) play a key role in the acid base balance. However, in chickens, current feeding strategies does not take into consideration the modulatory impact of dietary electrolyte balance (DEB) on Ca and P utilization. The objective of this project was to evaluate the impact of DEB and the contents of Ca and P in the diet on animal performances, systemic acid-base balance and bone mineralization. A total of 3600 one-day-old male broilers (Ross 308) were randomly assigned to the 8 treatments, with 9 replicates of 50 chicks per replicate. Animals received 3 feeding phases (0-10, 11-21 and 22-34 days). Two levels of DEB were utilized (Normal and low) in combination with two levels of Ca (Normal and low) and two levels of P (Normal and low). In total, eight treatments were generated. Animal performances and collection of blood samples were performed on days 10, 21 and 34. In addition, 4 birds per pen were utilized for DXA measurements to obtain bone mineralization. The data were analyzed using the SAS GLIMMIX. Pre-planned orthogonal contrast was used to assess the effects of Ca, P, DEB and their interactions. The average body weight at day 10 and 34 was greater ($P \leq 0.02$; interaction Ca*DEB) when animals received LowDEB and LowCa. The ADG increase was also observed at 10, 34 and 0-34 days, feeding LowDEB and LowCa diets ($P \leq 0.04$; interaction Ca*DEB). In the same vein, the cumulative average daily feed intake (0-34 days) was greater by LowDEB and LowCa (P=0.03; interaction Ca*DEB). At day 21, caecal pH was increased by NormalCa as compared with LowCa (P = 0.03). A tendency (P = 0.09) to increase blood pH was observed at day 21 by NormalDEB in comparison with LowDEB. Plasma ionized Ca (iCa), at day 21, was decreased (P = 0.001) by LowCa diets, whereas LowP and NormalDEB diets increased iCa ($P \leq 0.04$). At day 34, blood pH, bicarbonate, total CO_2 was increased ($P \leq 0.04$) by NormalDEB, suggesting an alkalosis condition at systemic level. Bone mineral density (% BW) was increased by NormalCa and NormalP (P = 0.004; interaction Ca*P). These results show, as opposed to previous studies, LowDEB improve animal performances. Similarly, content of Ca and P influence animal performance and systemic acid-base balance indicators. Bone mineralization is mostly affected by dietary Ca and P contents. The interaction DEB, Ca and P in the diets should be considered to achieve an optimal animal performance.