

Calcium – Phosphorus contents:

The effect of extreme Ca: P ratios on growth rate, feed intake, mortality and P- utilization in Japanese quail (Coturnix Jap.)

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Previous experiments have shown that Japanese quails are not susceptible to high levels of Ca even at very low levels of P. The present experiment was carried out to study the utilization of P under further extended Ca: P ratios. A total of 144 three weeks old quail chicks were randomly assigned to 9 treatments of 8 replicates each. The treatments comprised three levels of Ca (2.6, 3.0, and 3.3 %) and total P (0.10, 0.20, and 0.30 %) in a complete 2-factorial design. Body weight gain, feed intake and mortality were recorded from 3 to 6 weeks of age. Feces were collected and analyzed to determine the P-balance. Feed intake and body weight declined with increasing levels of Ca at the lowest level of P (0.10 %). There was no response at 0.20 and 0.30 % P. Neither of the treatments influenced mortality. The utilization of P varied from 25.34 to 70.44 %. There was a decrease of P-utilisation with increasing inclusion of Ca. The results show that the recommendations for P in quail diets are far above requirement. Growing quails are not susceptible to extreme levels of Ca when minimum requirement of P is provided.

Keywords: phosphorus; calcium; Ca- P interaction; quail.

Introduction

Improvement of the utilization of dietary P has been studied extensively with the aim to reduce excessive P excretion of livestock, which accumulates in agricultural soils. High Ca- levels in the diets are known to impair P- utilization in broilers and layers (Shafey, 1993; Härtel, 1989). Previous unpublished experiment with Japanese quails has shown that the high Ca: P ratios, ranging from 2.0 to 0.6 % did not negatively influence growth rate, feed intake and P-utilization in a P-balance experiment. The purpose of the present study was to examine the effect of further extended Ca: P ratios in quail diets on P- utilization.

Materials and Methods

A total of 350 quails from a commercial french meat type line were allocated to five boxes (80 x 80 x 64 cm, width x depth x height) with wire floor. The birds were raised on a quail starter diet containing 11.89 MJ UE/kg; 26.3 % Crude protein; 0.84 % Ca and 0.72 % total Phosphorus (P_t). Temperature was 38°C at day old and decreased gradually afterwards to 25°C. Infrared lights were used as heat source. These conditions were applied until the end of the third week of live. At the start of the fourth week, the birds were sexed and groups of two male birds each were transferred to cages measuring 18.5 x 38 x 22 cm (width x depth x height). Eight cages each were allocated to 9 different experimental dietary treatments. For adaptation to the diets a pre- experimental phase of 7 days was provided. For the balance period, which followed the pre-experimental period and lasted 7 days, one of the birds of each cage was removed so that each replicate was represented by one individual bird. A low-P basal diet was used to cover the birds' requirements of nutrients except P and Ca. This diet was developed and described by Dänner and Bessei (2001b). The desired levels of Ca and P were obtained by monocalcium phosphate (MCP) and calcium carbonate ($CaCO_3$).

The treatments 1-9 comprised three levels of Ca (2.6, 3.0, and 3.3 %) and P_t (0.10, 0.20, and 0.30 %) in a complete 2-factorial design. During the balance period from 5 to 6 weeks of age, the feces of each bird were quantitatively collected and immediately deeply frozen (- 18° C). Feed intake and body weight gain were recorded daily. The nutrient content of feed and feces were analysed. P- balance was calculated by the difference of P-intake and P-excretion and corrected for average daily feed intake. Data were subjected to a two- factorial analysis of variance. Differences of means were tested using student t- test. All statistical procedures were carried out by the statistical program JMP® Version 5 (2005).

Results and discussion

There was a tendency of decreasing body weight gain with increasing Ca level (table 1). However, neither Ca or P nor the interaction of both factors reached statistical significance ($p > 0.05$). With regard to feed intake only the interaction of Ca and P was significant ($p < 0.05$). Feed intake was depressed with increasing Ca level when the lowest P level (0.10%) was provided, while the opposite tendency was shown at the higher P-Level (0.30 %) (table 2). P-utilization was significantly influenced by both, P- and Ca. The group means of P-utilisation decreased from 63.29 % to 39.54% and 27.10 % at P-levels of 0.10, 0.20 and 0.30 % respectively (table 3).

Tab.1: Mean body weight gain in g per bird and week in response to different Ca and P levels.

P %	Ca %			Mean
	2.6	3	3.3	
0.10	50.87	36.12	39.87	42.28
0.20	46.62	43.50	41.25	43.79
0.30	40.25	50.25	38.87	43.12
Mean	45.89	43.29	39.99	43.06

Tab.2: Mean of feed intake in g per bird and week in response to different Ca and P levels.

P %	Ca %			Mean
	2.6	3	3.3	
0.10	220.37 ^a	187.87 ^b	190.87 ^b	199.7
0.20	218.12 ^a	188.87 ^b	210.50 ^{ab}	205.83
0.30	201.37 ^{ab}	217.50 ^a	219.37 ^a	212.74
Mean	213.28	198.08	206.91	206.09

Means ^{a-b} with different superscripts are significantly different ($p < .05$)

Tab.3: Corrected P- utilization in % for daily feed intake in response to different Ca and P levels.

P %	Ca %			Mean
	2.6	3	3.3	
0.10	70.44 ^a	53.22 ^b	66.21 ^a	63.29 ^a
0.20	45.35 ^{bc}	37.29 ^{cd}	35.97 ^{cde}	39.54 ^b
0.30	26.53 ^{de}	29.44 ^{de}	25.34 ^e	27.10 ^c
Mean	47.44 ^a	39.98 ^b	42.50 ^{ab}	42.72

Means ^{a-f} with different superscripts are significantly different ($p < .05$)

There was a significant decrease of P-utilisation when the Ca-level raised from 2.6 to 3.0 %, but the mean at the Ca-level of 3.3 % did not significantly differ from both other means. The present data of P-utilisation confirm the previous study of Dänner et al. (2002) where the highest P- utilization was obtained at the lowest level of P. They also confirm the finding of our previous unpublished results where extremely low levels of total P (0.10 %) did not produce problems in feed intake, growth rate and mortality (data not presented here), although the diet was fed for two weeks. It is generally acknowledged that excessive Ca led to the deterioration of growth rate and feed conversion in broilers (Shafey, 1993). Härtel (1989) reported serious depression in egg production, egg shell quality and high mortality under extreme Ca: P diets in the laying hens. This is explained by impaired P-availability with high Ca- levels. The effect of wide Ca: P ratio was only found for feed intake at the lowest P-level in the present study. A corresponding non-significant tendency was found for body weight gain. The decrease of P-utilisation at very high levels of Ca was relatively small, though the effect was significant. Shafy and McDonald (1990) showed that high Ca level (21.2 g/kg⁻¹) diets could be tolerated by broilers without negative effect on performance.

The results clearly show that (i) the recommendations for P in growing quails are far beyond requirement and (ii) that the growing quails are not susceptible to high levels of Ca even if low levels of P are provided. The cause for the lacking effect of high Ca- levels on P- utilization in quails need further investigation.

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