Effects of Dietary Supplementation of Zinc and α-Tocopheryl Acetate on Performance and Zinc Concentrations in Egg and Tissues of Japanese Quails

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Abstract

We investigated the effects of dietary supplementation of zinc (ZnO; 0, 40, 80, 120 and 160 mg/kg) and Vit E (α-tocopheryl acetate; 0 and 40 IU/kg) on egg production, egg quality and Zn content of egg fractions and tissues in Japanese quails. Using a 5 × 2 factorial design, a total of 960 Japanese quails (Coturnix coturnix japonica) at day 70 of age were housed in cages and randomly assigned into one of ten experimental treatments, each with four replicates of 24 birds (16 females and eight males per replicate). Egg production was greater (P < 0.05) in birds fed diets containing 160 mg/kg of zinc (Zn) than those fed basal diet (control diet), but vitamin E supplementation had no effect on egg production. Quails fed basal diet supplemented with 80 mg/kg Zn showed a significant improvement in their feed conversion ratio compared to the other birds. Birds supplemented with 80, 120 and 180 mg/kg Zn had stronger egg shells than those fed the control diet, while shell thickness was lower in birds supplemented with 0 and 40 mg/kg of Zn (P < 0.05). Enrichment of Zn in egg yolk increased when birds received diets supplemented with 80, 120 and 160 mg/kg Zn compare to control group (P < 0.05). Supplementation of diet with Zn increased serum concentration of Zn when fed to quails at 120 mg/kg (P < 0.05). Thigh muscle, thigh bone, and liver Zn concentrations increased with concentration of Zn supplementation (P < 0.05). Vitamin E supplementation had no effects on laying performance, egg shell quality, and Zn concentrations in egg fractions and tissues of Japanese quail.

Introduction

Quail production has steadily grown over the past few years because of its high profit and low initial investments (Prabakaran, 2003). Quail rearing, like all types of poultry production, could be profitability optimized with scientific feeding and understanding of quail nutrient requirements. Commercial producers have recently shown great interest in examining the effects of supplemental zinc and vitamin E on quail raising profitability. Such concerns are derived mainly from scarcity of information on quail zinc (Zn) requirements despite numerous reports confirming its promising effects (along with other minerals and vitamins) on growing broilers and laying hens. Zinc is a trace element necessary for normal growth, bone development, feathering and regulation of appetite in all avian species (Batal et al., 2001). Zinc is also involved in many enzymatic and metabolic functions in the

Keywords

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body (Prasad and Kucuk, 2002): activities of several metabolic enzymes drastically decrease in Zn-deficient animals (Prasad and Kucuk 2002). Scaling of skin, especially on feet, and increased mortality have also been observed in severe cases of Zn deficiency in stressed birds (Sahin et al., 2009). In a 24-week trial, supplementing laying hen rations with 48 mg/kg of Zn had no effect on egg production (Supplee et al., 1958). In contrast, Kienholz et al. (1961) found that laying hens fed a soy-based diet containing 10 mg/kg of Zn had lower egg production and hatchability than normal until diets were further supplemented with additional Zn. Since most feed ingredients are marginally deficient in Zn, it is of utmost importance to supplement poultry diets with an additional source of Zn. However, Stahl et al., (1986) found that supplementing diets of laying hens with Zn had no effect on egg production, feed intake, and feed conversion ratio (FCR). Japanese quails are particularly sensitive to dietary Zn deficiency, and it has found that Zn is necessary for their normal growth, feathering and normal skeletal development (Korineková et al., 2005). Therefore, quails may benefit from with Zn supplements.

Poultry cannot synthesize vitamin E. Therefore, their requirements for vitamin E must be fulfilled via dietary sources (Chan et al., 1994). Supplementing laying hen diets with vitamin E increased egg production and oxidative stability, and improved the quality of eggs (Cherian et al., 1996a). Sahin et al., (2006) found no effect on body weight, feed intake, and egg weight in Japanese quail supplemented with vitamin E, though egg production increased. Vitamin E, as a biological antioxidant, has been added to animal diets to improve feed efficiency and immune response. Vitamin E supplementation can also improve the quality of meat and eggs, and increase their vitamin E content for the consumers (Sunder et al., 1997). Salgueiro et al. (2000) and Kim et al. (1998) demonstrated that Zn, which is involved in some biological antioxidant systems, interacts with vitamin E, because vitamin E status was impaired in Zn-deficient animals. Therefore, this study aimed to investigate the effects of dietary supplementation of zinc and vitamin E on production performance and egg quality of breeder Japanese quail.

Materials and Methods

Experimental flock and dietary treatments

All procedures used in this study were approved by Animal Care Committee of Ramin Agriculture and Natural Resources University, Khuzestan, Iran. Nine hundred and sixty 70-d old Japanese quail (Coturnix coturnix japonica) were purchased from a commercial breeder flock. The birds were housed in battery cages (60 cm wide × 100 cm long × 28 cm high) equipped with a raised wire floor, and acclimatized to experimental diets and cages for two weeks. The ambient temperature of hen house was kept between 18 to 26°C. The experimental period lasted 70 d, and throughout this period, birds were subjected to a 16L:8D photoschedule. A corn-soybean basal diet was supplemented with Zn as zinc oxide with 74.5% zinc (0, 40, 80, 120 and 160 mg/kg) and vitamin E as DL-α-tocopheryl acetate (0 and 40 IU/kg), creating ten experimental treatments. The basal diet was formulated to meet or slightly exceed the nutrient requirements of layer Japanese quail recommended by the NRC (1994; Table 1).

The birds were randomly assigned to one of the ten experimental treatments with four replicates of 24 birds each (sixteen females and eight males). Diets (in mash form) and water were offered to the birds ad libitum throughout the experimental period.

Data Collection

Daily egg production and egg weight were recorded for each cage. Feed intake (FI) was measured weekly and was used to calculate feed conversion ratio (FCR; feed intake divided by weight of eggs produced). Egg mass was calculated as egg weight multiplied by percentage of egg production to estimate grams of egg produced per day. On Day 70 of experiment, one female quail from each group was slaughtered using HALAL procedures and liver and thigh muscles were taken for Zn analysis. On the tenth week of the experiment, two eggs were randomly selected from each group and Zn concentration was determined in the egg yolk, egg white and eggshell individually. To determine strength, thickness, and eggshell proportion, six eggs from each treatment were randomly selected on days 42 and 70 of the experiment and were weighed, broken, and proportional weights of yolks and whites were calculated. The residue of whites were wiped from eggshells, and yolk, white, and eggshell were dried for 48 hrs at 60°C.