Effects of zinc oxide nanoparticles on growth performance and concentrations of malondialdehyde, zinc in tissues, and corticosterone in broiler chickens under heat stress conditions

ABSTRACT

The use of nanominerals, such as nano-zinc, represents a promising and emerging technology in the animal farming industry. Due to the small particle size and bioavailability of nano-zinc, it can be easily assimilated in the digestive system, thereby reducing excretion and environmental pollution. The present study was conducted to assess the effects of zinc oxide nanoparticles (ZnONPs) on the growth performance, zinc (Zn) concentration in edible tissues, thiobarbituric acid reactive substance, and corticosterone concentrations in broilers reared under normal or heat stress environmental conditions. The experiment was performed with a completely randomized design based on a 4 × 2 factorial arrangement consisting of 4 diets (basal diet + 60 mg/kg conventional zinc oxide as control diet; basal diet + 40 mg/kg of ZnONPs; basal diet + 60 mg/kg of ZnONPs; and basal diet + 100 mg/kg of ZnONPs) and 2 environmental conditions (normal and heat stress). On day 22, birds from each dietary group were divided equally to normal temperature (23 ± 1°C throughout) or heat stress conditions (34 ± 1°C daily for 6 h from 10:00 am until 4:00 pm). From 1 to 42 D of age, the broiler chickens fed 100 mg/kg ZnONPs exhibited lower feed intake and feed conversion ratio than the control. The accumulation of Zn in the liver of broilers was significantly higher among all treatment groups compared to breast and thigh muscle tissues regardless of the temperature conditions. At 40 and 60 mg/kg ZnONPs, the malondialdehyde content increased in thigh muscle of broilers at 7 D postmortem, indicating that ZnONPs potentially inhibited the antioxidant system in muscle tissues. The control and ZnONPs at 40 mg/kg and 60 mg/kg led to low serum corticosterone levels that may be attributed to the antioxidant and antistress properties of Zn. Taken together, although supplementation with ZnONPs at 40 mg/kg and 60 mg/kg alleviated the negative results of heat stress, further research is needed to determine the optimal level of dietary ZnONPs supplementation.

Keyword: TBARS; Broiler chicken; Nanoparticles; Serum corticosterone; Zinc oxide