Effects of high dietary levels of citric acid on productive performance, serum enzyme activity, calcium and phosphorus retention and immune response in broiler chickens

Einfluss hoher Zulagen von Zitronensäure zum Futter auf die Leistung, die Enzymaktivität im Blutserum, die Retention von Kalzium und Phosphor sowie auf die Immunantwort von Broilern

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Introduction

Organic acids are nowadays well recognised as non-antibiotic feed additives in poultry nutrition (WINDISCH et al., 2008). These compounds are primarily used to prevent pathogen contamination such as Salmonella through sanitising feed ingredients (THOMPSON and HINTON, 1997). However, experimental results showed that dietary administration of organic acids improve nutrient digestion and absorption, mucosal immunity and exert topical effects on the intestinal brush border in broiler chicken (VIVEROS et al., 2002). KIRCHGESSNER and ROTH (1982) reported that particular organic acids increase pepsin proteolysis and trigger the release of gastrin and cholecystokinin hormones which regulate the digestion and absorption of proteins and lipids.

Citric acid (CA) is one of the most widely used organic acids used in food industry and poultry feed. It acts as a growth promoter through acidifying the gastrointestinal (GI) content and is considered a favourite determinant in effective nutrient digestion (ANJUM and CHAUDHRY, 2010). In addition, CA improves the solubility of feed ingredients, digestion and absorption of the nutrients by reducing the intestinal pH, (CENTENO et al., 2007). VIVEROS et al. (2002) showed that dietary administration of acidifiers decreases the population of pathogenic bacteria, and alters the nutrient uptake in favour of the host.

To exhibit the above mentioned beneficial effects, CA is mostly included in broiler diets at doses ranging from 5 to 30 g kg⁻¹ (ANJUM and CHAUDHRY, 2010; ISLAM, 2012). Experimental results on dietary inclusion of CA in greater levels than 30 g/kg⁻¹ in broiler chicken (BOLING et al., 2000; CENTENO et al., 2007; SALGADO et al., 2011) have conflicting results with some results supporting the increased levels of CA in broiler diets while others reporting certain disadvantage such as suppressed growth performance and disrupted mineral metabolism (CENTENO et al., 2007; NOURMOHAMMADI et al., 2012). It was hypothesised that increased dietary levels of CA may exert beneficial health and growth performance effects in broiler chickens. To test this hypothesis, the current study was conducted assessing the effects of dietary CA at a high dose of 60 g kg⁻¹ compared to the more accepted level of 30 g kg⁻¹ of diet on productive performance, certain blood metabolites and immune response of broiler chickens up to day 42 of age.

Materials and methods

Experimental flock

All procedures for this experiment were conducted according to the guidelines of the IRANIAN COUNCIL OF ANIMAL CARE (1995). A total of 350 one-day-old Ross 308 male broiler chickens were obtained from a commercial hatchery (Jonobekhorasan Ross Breeders Co., South Khorasan, Iran) and raised on wood shavings litter in a concrete floor grow-out broiler house up to day 7 of age. The birds received a maize-soybean meal based starter diet in mash form