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Efficacy of dimethylglycine as a feed additive to improve broiler production

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ABSTRACT

Dimethylglycine (DMG) is a naturally occurring glycine derivative, which is useful as additive to broiler diets as it improves nutrient digestibility and reduces the development of broiler ascites syndrome. This study evaluated the efficacy of dietary DMG to enhance performance of broiler chickens. Three trials were conducted to evaluate the effect of dietary supplementation with 1 g Na DMG/kg on growth performance and carcass characteristics. In Trial 1, the effect of sex was also assessed in a 2×2 factorial arrangement of treatments. In Trials 1 (Germany), 2 (Austria), and 3 (Italy), each treatment consisted of 6, 12, and 11 replicate pens with 20, 15, and 16 one-day-old broiler chickens per pen, respectively. Dietary DMG supplementation resulted in improved feed conversion ratio (FCR) in the starter phase by 8.8% ($P=0.004$), 6.4% ($P=0.001$), and 4.8% ($P=0.006$) compared with the control diet in Trials 1, 2, and 3, respectively. The overall FCR improved in broiler chickens fed the diets supplemented with DMG by 3.8% and 4.1% in Trials 1 ($P=0.007$) and 3 ($P=0.006$), respectively. In addition, final body weight increased by 5.5% ($P=0.001$) in Trial 2 and production value improved by 6.8% ($P=0.015$) in Trial 1 by dietary DMG supplementation. Mortality in all trials was similar between dietary treatments. In all 3 trials, cold carcass weight and total meat yield were as well similar between broiler chickens fed the control and DMG diets. In Trial 1, dietary DMG had no effect on breast meat yield in male broiler chickens, but it increased breast meat yield in female broiler chickens (diet × sex, $P=0.004$). Organoleptic quality of roasted breast meat assessed only in Trial 2 was not affected by dietary treatments. In conclusion, dietary supplementation of DMG at 1 g Na DMG/kg can considerably improve ~~s~~ production performance in broiler chickens.

1. Introduction

Dimethylglycine (DMG) is a naturally occurring tertiary amino acid in the intermediary metabolism of betaine in living organisms. Dietary supplementation in broiler diets

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results in improved apparent faecal digestibility of the crude protein and carbohydrate fraction. This is hypothesised to result from an emulsifying effect of DMG in the intestinal tract, which allows non-fat nutrients to be more efficiently absorbed, rendering more nutrients available for utilisation (Kalmar et al., 2010; Prola et al., 2013). Dietary DMG has also been shown to improve carcass characteristics by decreasing fat deposition and increasing meat yield. These changes are linear in the range between 0 and 1 g Na DMG/kg feed and are more pronounced with increased level of dietary polyunsaturated fatty acids (Kalmar et al., 2011). Kalmar et al. (2011) suggested enhanced utilisation of dietary fat as an energy source as a possible underlying basis. Namely, dietary fat is utilised as a source of energy, instead of being deposited as body fat. Consequently, less protein is used to provide energy, which promotes lean growth. Therefore, dietary DMG not only reduces feed costs, but also has potential environmental benefits because of improved protein utilisation, which has been demonstrated by reduced N excretion into urine (Kalmar et al., 2010). Possibly, DMG also influences hepatic gene expression by affecting DNA methylation, as has been demonstrated for other methylamine derivates (Emmert et al., 1996; Niculescu et al., 2006). Effects of dietary DMG on hepatic gene expression are currently under investigation.

The aim of this study was to assess the efficacy of dietary supplementation with DMG at a level of 1 g Na DMG/kg to improve broiler performance. Three broiler trials were conducted at different European locations, at which distinct broiler strains and basal diets were used.

2. Materials and methods

2.1. Experimental design and treatments

Three broiler trials were conducted at different European locations. Trial 1 was conducted at the Free University of Berlin (Berlin, Germany). Trial 2 was conducted at the poultry trial station in Äussere Wimitz (Kraig, Austria). Trial 3 was conducted at the certified (ISO 9001) poultry farm, "Luca Fornello" in Settimo (Torinese, Italy). In each trial, 1-d-old broiler chickens were randomly allocated to pens and fed control, basal diets or basal diets supplemented with 1 g Na DMG/kg. In all trials, feed was offered *ad libitum*.

2.2. Animals and management

Housing conditions were in all trials in compliance with the minimal space restrictions according to the revised European Treaties series no. 123 (ETS 123). Ingredient, and energy and nutrient composition of basal diets are presented in Tables 1 and 2, respectively.

2.2.1. Trial 1

A total of 480 one-day old broiler chickens (Cobb Germany Avimex GmbH, Regenstauf, Germany) were randomly assigned to 12 pens with 20 females and 12 pens with 20 males, and reared until 39 d of age. Pens were randomly assigned within sex to 2 dietary treatments with 6 replicate male pens and 6 replicate female pens per treatment. A 3-phase feeding programme was used with a starter diet from day 1 until day 14, a grower diet from day 15 until day 28, and a finisher diet from day 29 until day 39. Each floor pen was 2.2×1.8 m (length $\times$ width) and had softwood shaving litter as bedding. Lighting schedule was 24 h light during the first 3 d, followed by 23 h light:1 h darkness until day 7, and then 18 h light:6 h darkness until slaughter. Ambient temperature was kept at 28 °C during the first 2 wk, and after day 15, it was reduced by 0.5 °C per day until 22 °C was reached. Additionally, the temperature at the surface of the bedding was monitored and maintained at about 34 °C by infra-red heaters until day 21. Relative humidity was $60.0 \pm 3.5\%$. All birds were vaccinated against coccidiosis (Paracox; Essex Pharma GmbH, Munich, Germany) at 9 d of age by individual oral application at the dose level of 0.1 mL/broiler chicken.

2.2.2. Trial 2

A total of 360 one-day old Ross 308 broiler chickens were randomly allocated in 24 pens of 15 unsexed chickens and reared until 36 d of age. A three-phase feeding programme was used with a starter diet from day 1 until day 14, a grower diet from day 15 until day 28, and a finisher diet from day 29 until day 36. Each floor pen was 2.0×1.5 m (length $\times$ width), and had wood shavings as litter. Lighting schedule was 24 h light during the first 3 d, followed by 22 h light:2 h darkness until slaughter. Ambient temperature was initially kept at 28 °C and gradually reduced to 20 °C.

2.2.3. Trial 3

A total of 352 one-day old Ross 508 broiler chickens were randomly allocated in 22 pens of 16 birds of both sexes (8 males and 8 females) per pen, and reared for 35 d. A 2-phase feeding programme was used with a starter/grower diet from day 1 until day 21 and a finisher diet from day 22 until day 35. Each pen was 1.5×1.0 m (length $\times$ width), and had rice hulls as litter. Lighting schedule was 23 h light:1 h darkness until day 7 and 18 h light:6 h darkness until slaughter. Infrared lamps were used for heating during the first 3 wk. Minimum and maximum temperatures were 21.9 and 30.4 °C in the starter-grower period and 22.4 and 26.3 °C in the finisher period. At hatching, chicks were vaccinated against coccidiosis, Newcastle disease, and infectious bronchitis (Izovac I.B. H120; Izo S.p.A., Brescia, Italy). The vaccine against coccidiosis was administered in the drinking water, while those for Newcastle disease and infectious bronchitis were administered by inhalation.

2.3. Assessed variables

Body weight (BW) and feed remainders were recorded at the beginning and end of all feeding phases. Mortality was recorded daily. Average daily gain (ADG), average daily feed intake (ADFI), and feed conversion ratio (FCR) were calculated for each feeding phase. Production value (PV) were calculated as follows: PV = [100 − mortality (%) × BW (g)]/[rearing period (d) × FCR × 10].

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