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Short communication

Effects of dietary supplementation with oregano essential oil on growth performance, carcass traits and jejunal morphology in broiler chickens

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ABSTRACT

This study was conducted to investigate the effects of diets containing oregano essential oil (OEO) on growth performance, carcass traits and intestinal morphology of broilers during a 42-day production period. A total of 448 one-day-old Arbor Acres broilers were randomly distributed into 4 dietary treatments with 7 replicate pens per treatment and 16 birds per pen. The dietary treatments were as follows: (1) corn-soybean basal diet (control, CON), (2) CON + 8 mg/kg avilamycin (AVI), (3) CON + 300 mg/kg OEO preparation (OEO300), and (4) CON + 600 mg/kg OEO preparation (OEO600). The results showed that both OEO300 and OEO600 groups increased ($P = 0.007$) the final body weight compared to the CON group. On day 21, OEO600 increased average daily gain (ADG) and lowered feed conversion ratio (both $P < 0.05$) compared to the CON. On day 42, both OEO300 and OEO600 groups increased ($P < 0.05$) ADG and average daily feed intake (ADFI) compared to the CON. Moreover, OEO600 increased ($P < 0.05$) ADG and ADFI compared with AVI. Carcass parameters were similar among avilamycin and OEO preparation treatments. Avilamycin and OEO supplementation improved ($P < 0.05$) the dressing percentage and eviscerated rate compared with CON. The broilers fed with OEO600 had the highest ($P = 0.003$) breast muscle percentage, and the lowest ($P = 0.008$) abdominal fat percentage. All treatments had no effect on the villus height in the jejunum of broilers. However, OEO300 and OEO600 decreased ($P = 0.000$) the crypt depth and increased ($P = 0.000$) the villus height to crypt depth ratio compared with CON and AVI, which may contribute to the improvement of growth performance. In conclusion, OEO supplementation exhibited a significantly positive effect on the growth performance, carcass traits and intestinal health of broilers, indicating that OEO may be a promising alternative to antibiotic growth promoters.

Abbreviations: ADF, laverage daily feed intake; ADG, average daily gain; AGP, santibiotic growth promoters; BW, body weight; CD, crypt depth; FCR, feed conversion ratio; OEO, oregano essential oil; VCR, villus height to crypt depth ratio; VH, villus height; VLDL, very low density lipoproteins.

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1. Introduction

The use of antibiotics as growth promoters in animal feed has been banned in European Union since January 2006. The Guidance for Industry #213 published by the Center for Veterinary Medicine (2013) would help to phase out the use of medically important antimicrobial drugs in food-producing animals for production purposes over three years. In this case, non-antibiotic animal husbandry is a trend in the world. Many investigations have been conducted to search for natural alternatives with similar beneficial effects to antibiotic growth promoters (AGPs) for using in the animal industry. For instance, phytogenic feed additives, such as essential oils, are natural and residue free which make them received increasing attention as potential alternatives for AGPs (Windisch et al., 2008).

The major components of oregano essential oil (OEO) extracted from *Origanum* genus are carvacrol and thymol, representing together up to 85% of the essential oil (Burt, 2004). OEO is classified as generally recognized as safe by the United States Food and Drug Administration and has beneficial effects on the intestinal microflora (Jamroz et al., 2005; Jang et al., 2007), feed utilization (Lee et al., 2003b), and digestive enzymes stimulation (Hashemipour et al., 2013). However, the effects of OEO on growth performance of poultry were inconsistent. Supplementation of OEO was shown to improve growth performance of poultry in a few studies (Khattak et al., 2014; Pirgozliev et al., 2015); in contrast several other studies reported that OEO had no significant effect on animal performance (Lee et al., 2003a; Jang et al., 2007).

Excessive fat deposition, especially abdominal fat, is less desired by broiler processors and consumers; therefore, profitable poultry meat production depends primarily on the ability to increase carcass muscles and to decrease abdominal fat (Griffin, 1996). Some studies demonstrated that the dietary supplementation with essential oil could improve the carcass traits of broilers (Alcicek et al., 2003; Khattak et al., 2014). However, the effect of OEO on abdominal fat of broilers is unclear. Intestinal morphology, especially the crypt and villus morphology, is an important indicator of intestinal health playing a significant role in nutrient digestion and absorption (Wang and Peng, 2008); however, there is very limited information on the effects of OEO on morphology of small intestine of broilers (Sun et al., 2015). From all the above mentioned reports, it seems that the response of broiler chickens to the dietary inclusion of OEO is not clear. Therefore, this study was conducted to evaluate the effects of OEO supplementation to basal diet on growth performance, carcass traits and jejunal morphology of broilers, and accordingly estimate the potential of OEO as an alternative for AGPs.

2. Materials and methods

2.1. Test substance

The OEO preparation, Orsential™ Dry (light yellow to yellow, free-flowing powder), was provided by Kemin Industries (Zhuhai) Co., Ltd., (Zhuhai, China). It was composed of combination of oregano essential oils containing a high content of carvacrol or thymol; defatted rice bran and silica were used as carriers. It contained a minimum of 22 g/kg of carvacrol and a minimum of 11 g/kg of thymol. The analyzed values of carvacrol and thymol determined by our method were 26.4 g/kg and 13.0 g/kg, respectively.

2.2. Birds, diets and management

The trial was performed according to the animal welfare regulations of China. A total of 448 one-day-old Arbor Acres broilers were obtained from a local hatchery. The broilers were weighed at day 1 and randomly distributed into 4 treatments with 7 replicate pens per treatment with 16 birds per pen. The corn-soybean meal-based diets (Table 1) were formulated to meet or exceed the nutritional requirements as recommended by NRC (1994) for broilers. The dietary treatments were as follows: (1) basal diet (control, CON), (2) CON + 8 mg of avilamycin/kg of diet (AVI), (3) CON + 300 mg/kg OEO preparation (OEO300), and (4) CON + 600 mg/kg OEO preparation (OEO600). All chicks were vaccinated for Newcastle Disease Virus on day 7 and day 21 and Infectious Bursal Disease on day 14. The birds received a lighting regimen of 23L:1D during the entire period. Mash feed and water were provided *ad libitum*.

2.3. Growth performance parameters

During the experimental period of 42 days, birds were weighed by pen and feed intake was recorded on day 1, day 21 and day 42 and average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR) were calculated accordingly.

2.4. Carcass traits

At the end of the feeding trial, two birds from each pen with body weights close to the average value were selected, individually weighed, and humanely slaughtered. The abdominal fat, breast and leg muscles were removed and weighed for the measurements of carcass traits. Carcass weight was measured after defeathering. Dressing percentage was calculated by dividing the carcass weight by live weight. Head, neck, and hocks were removed from broilers and then the eviscerated