Effects of artichoke (Cynara scolymus L.) extract on antioxidant status in chicken thigh meat

Mirderikvandi, M.1, Kiani, A.1, Khaldari, M.1, Alirezaei, M.2

1Animal Sciences Group, Faculty of Agriculture, Lorestan University, Khorram Abad, Iran
2Division of Biochemistry, School of Veterinary Medicine, Lorestan University, Khorram Abad, Iran

Abstract:
BACKGROUND: Artichoke extract (AE), containing natural antioxidant compounds, can be considered as a good source of antioxidant potential. OBJECTIVES: The aim of this study was to evaluate antioxidant abilities of AE on broiler meat quality. METHODS: 200 Ross chicken broilers were divided into five equal groups and received 100, 200, 300, and 500 mg/liter of AE in drinking water and pure water in the control group, respectively. Antiradical activity and phenolic content of AE were determined by 1,1-diphenyl-2-picrylhydrazyl (DPPH) method and gallic acid measurement before adding extract into drinking water. The broilers received AE extract from 21-35 day of growing phase and the samples from thigh muscles were taken for biochemical analysis in the 42 day of the growing phase. RESULTS: Antiradical activity of AE was 35% and phenolic content was 3.3g/100g of dry extract. Regarding antioxidant enzymes, such as glutathione peroxidase (GPx) and catalase (CAT), the AE with dosage of 200 mg/l indicated maximum antioxidant ability compared to the other groups (p<0.05). Supplementation of AE200 mg/l also demonstrated the lowest GPx and CAT activities, compared to the control and AE 300 mg/l groups (p<0.05). Regarding performance weight gain, average daily weight gain, percentage of weight gain in 21 to 35 as well as final weight were similar in control and AE-received groups and AE indicated similar effect for all the treatments. CONCLUSIONS: This study showed that administration of 200 mg/l AE in drinking water during growing phase decreased GPx and CAT activities in chicken meat presumably due to down-regulation of gene expression for antioxidant enzymes.

Key words: Artichoke extract, broiler chicken, glutathione peroxidase, lipid stability

Introduction

It is well-known that lipid peroxidation is one of the main factors limiting the quality and acceptability of meat (Morrissey et al., 1998). Usually, lipid peroxidation occurs when antioxidant defenses (non-enzymatic and enzymatic antioxidants) are overcome by peroxidation mechanisms and lipid peroxidation refers to oxidation of lipids in the presence of oxygen (Gutteridge, 1995). During the oxidation of lipids, unsaturated fatty acids are oxidized in presence of reactive free radicals, such as superoxide anion, hydroxyl radical, and hydrogen peroxide. Unsaturated fatty acids exposed to oxygen produce compounds, such as...
malondialdehyde (MDA), therefore, MDA has been widely used as an indicator of lipid peroxidation in meat (Alirezaei et al., 2012). The antioxidant system contains non-enzymatic and enzymatic antioxidants (Sies, 1997). Glutathione peroxidase (GPx), catalase (CAT), and superoxide dismutase (SOD) are enzymatic antioxidants. SOD converts superoxide anion into hydrogen peroxide (H2O2). Then, CAT removes hydrogen peroxide by converting it into water and oxygen. GPx also removes hydrogen peroxide by oxidizing the glutathione into its oxidized form (Gutteridge, 1995), and also converts H2O2 into water. Natural components including phenolic acids, flavonoids, polyphenols, retinoids, tocopherols, and ascorbic acid act as non-enzymatic antioxidant (Chu et al., 2000).

A number of byproducts as sources of natural antioxidant compounds have been studied, such as Oregano, Sage, and Rosemary on meat quality of broilers (Bustoglou et al., 2002; Lopez-Bote et al., 1998). Artichoke (Cynara colymus L.), as a rich source of non-enzymatic antioxidants, is a potential good source of antioxidant activity since it contains polyphenolic compounds, with mono- and dicaffeoylquinic acids as the major chemical components (Table 1). The most well-known caffeoylquinic acid derivative identified in artichoke is cynarin. The other phenolics are the flavones apigenin and luteolin, and the anthocyanidins cyanidin, peonidin, and delphinidin have also been found in artichoke (Lattanzio et al., 2009).

The aim of the present study was to evaluate antioxidant effect of AE in drinking water on meat quality of broilers. This effect was evaluated by antioxidant enzyme activities, such as GPx and CAT and lipid peroxidation marker as shown by MDA content.

Materials and Methods

Birds and treatments: A total of 200 one-day-old broiler chickens (Ross) obtained from a commercial hatchery (Dorbal Company, Boroojerd, Iran) were used in the present study. The chickens received 5% sugar and lemon juice mixture for 15 hours as soon as they arrived to the hall. The chickens were fed and reared according to Ross guidelines with similar diets throughout the experiment. All chickens were fed pre-starter (0.0-10 days), starter (11-21 days), grower (22-35 days), and finisher (36-42 days) diets. The ingredients and nutrient contents of the diets are shown in Table 2. The chickens had freely accessed to drinking water and exposed to 23 hours of light and 1 hour of darkness, daily. Vaccinations were performed against Newcastle and Bronchitis on the 4th and 18th days of the experiment. From day 21, chickens were randomly allocated into five treatments. Each treatment included 40 birds (male and female equally). AE obtained from Barij Essence Company (Kashan, Isfahan, Iran) (99% purity) was added to the chickens’ drinking water from day 21 to day 35 of the experiment (Nateghi et al., 2013).

Drinking water was either with 100 (AE100), 200 (AE200), 300 (AE300), and 500 (AE500) mg per liter of AE or without AE (control group). At the end of the experiment (42 d), 40 chickens (8 chickens per each treatment) were randomly selected and slaughtered. Meat samples were taken from thigh muscles and were stored at -80°C for one month. Animal care, slaughter, and sampling methods used in the present study were approved by the Institutional Animal Care and Use Committee (IACUC) of Lorestan University.

Antiradical activity and phenol content determination: Radical scavenging activity of AE was determined using DPPH method according to Burits and Bucar (2000). In brief, different concentrations of ascorbic acid (0.0, 2, 4, 6, 8 and 10 μmol) were taken in different test tubes. The volume was adjusted to 100 μl by adding methanol. For drawing curve calibration, five ml of a 0.1 mM methanolic solution of DPPH was added to the standard