Effect of Dietary Supplementation of Wild Grape on the Antioxidative Potential of the Breast and Leg Meat of Broilers

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Abstract

This study investigated the effect of wild grape (Vitis coignetiae) dietary supplementation on the antioxidative potential and quality of the breast and leg meat of broilers. A total of 36 one-day-old male Cobb broiler chicks were obtained from a commercial hatchery, and randomly assigned to 9 pens with 4 birds per pen. Then, broilers were fed 3 different dietary supplemetations, including 0%, 0.25%, or 0.5% wild grape, for 2 wks at the finishing period. After slaughtering, the total phenolic content, α,α′-diphenyl-β-picryl-hydrazyl (DPPH) radical scavenging activity, 2-thiobarbituric acid reactive substances (TBARS), and total cholesterol content of broiler breast and leg meat were measured. Higher total phenolic content was recorded in the leg meat of broilers fed the wild grape when compared with the control, while breast meat did not show any difference. Dietary supplementation of 0.25% and 0.5% wild grape significantly increased DPPH radical scavenging activity of both breast and leg meat. TBARS values of both breast and leg meat were decreased by supplementation of 0.5% wild grape during storage when compared to the control, except for the leg meat at day 7. However, there was no significant difference found in total cholesterol content in both breast and leg meat. The results indicate that the antioxidative potential of broiler meat is improved by supplementing the diet with wild grape.

Key words: wild grape, antioxidative potential, lipid oxidation, total cholesterol content

Introduction

Since ancient times, meat has played a vital role in the human diet, mainly as an excellent source of protein with high biological value. In addition, meat and meat products are important sources of fat, essential amino acids, minerals, and vitamins (Biesalski, 2005). Chicken meat is well recognized as a nutritional and healthy animal food, due to its relatively low fat, calorie, and cholesterol content, as well as its relatively high concentration of polyunsaturated fatty acids and protein content (Lee et al., 2012; Liu et al., 2012). However, oxidation in meat and meat products is a major problem in the meat industry (Kang et al., 2012). Furthermore, chicken meat is more liable to lipid oxidation, and thereby to the development of “off-flavors,” because it contains higher levels of unsaturated fatty acids compared to red meat. This issue presents a major problem with respect to retaining the quality of chicken meat for longer periods of time.

For this reason, antioxidants are added to fresh and processed meat to delay the onset of oxidative processes and loss of meat quality. In effect, antioxidants extend the storage period of meat by inhibiting the initiation or propagation of oxidative chain reactions (Xiong et al., 1993). In general, natural antioxidants are preferentially used in many products in the food industry over synthetic antioxidants, such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA), which may be carcino-genic to consumers (Branen, 1975; Huang et al., 2011; Reishe et al., 1998). Therefore, research in this field is now primarily focused on natural antioxidants, which ultimately provide higher consumer acceptability, palatability, safety, and potential to improve the functional aspects of meat (Brenes et al., 2008; Jo et al., 2009; Jung et al., 2010).

Recent studies have demonstrated the beneficial effect of plant originated phenolic compounds, which contain antioxidant potential via redox properties, in addition to having several beneficial actions on human health (Cathe-rine et al., 1997; Fraga et al., 2010; Kafakaya, 2004). Grape and tea are of special interest as natural polyphenol
antioxidants, due to their high phenolic compound content (Banon et al., 2007). These polyphenols are well known for their beneficial functions, such as the inhibition of lipid oxidation, cancer, or microbial growth, in addition to the suppression of blood pressure or atherosclerosis, prevention of diabetes, and the reduction of allergenicity (Byun et al., 2004; Catherine et al., 1996; Fraga et al., 2010; Mazza, 1998). Furthermore, the antioxidant potential of grape polyphenols has been confirmed in studies conducted using fish oil, frozen fish, cooked pork patties, and cooked turkey stored under retail display conditions (Banon et al., 2007). Previous studies have demonstrated that the negative outcome of lipid oxidation in chicken meat may be reduced by supplementing the diet of live chicken with antioxidants, such as medicinal herb mix and grape pomace (Jung et al., 2010).

Wild grape (Vitis coignetiae) is considered to be a rich source of mineral, dietary fiber, organic acids, water-soluble vitamins, and phenolic compounds, including resveratrol, epicatechin, catechin, procyanidin, and anthocyanin (Cheon, 1999; Jeong et al., 2007; Kim et al., 2006). In a study conducted by Yoon and Kim (2007) on total phenolic compounds and antioxidant activity of fruits (including strawberry, kiwi, apple, and wild grape), wild grape contained the highest amount of phenolic compounds, and exhibited over twice the antioxidant activity of a grape cultivar (Vitis labrusca). In addition, feeding fermented wild grape by-products to pigs decreased the 2-thiobarbituric acid-reactive substances (TBARS) values and cholesterol content of pork, as well as increasing its color, taste, flavor, and juiciness (Park and Jung, 2005). Won (2009) reported that wild grape juice increased the antioxidative activity of the blood and liver of rats that were fed high oxidized lipids. Furthermore, Yong et al. (2012) recently reported an improvement in the quality and freshness of eggs from layers that were fed wild grape powder.

Thus, the objective of this study was to investigate the effect of providing wild grape as a dietary supplement on the antioxidative potential of broiler breast and leg meat.

Materials and Methods

Preparation of animals and samples

A total of 36 one-day-old male Cobb broiler chicks (Cobb strain) were obtained from a commercial hatchery, and randomly assigned to 9 pens with 4 birds per pen. During the entire experiment, broilers were housed under 24 h fluorescent lighting, standard temperature, humidity, and ventilation conditions, and had ad libitum access to water and food. The broiler chicks were fed a commercial broiler starter diet (0-6 d), then, fed grower diets (7-21 d). At the end of week 3, broilers were reassigned to 3 different dietary treatments, and reared for a further 2 wks. Each treatment had 3 replicates, with 4 broilers in each replicate (total n = 36). Dietary treatments consisted of a control (commercial finisher diet with no supplementation), and finisher diets supplemented with 0.25% (WG-0.25), and 0.5% wild grape powder (WG-0.5), respectively.

At the end of the feeding trial, broilers from each pen were slaughtered, and the feathers and entrails (evisceration) were removed from the carcasses. Breast and leg meat were then dissected from each carcass, vacuum packaged, and stored in a deep freezer at -50°C until the analysis.

Measurement of antioxidative activity

The meat samples (3 g) were homogenized (T25b, Ika Works (Asia), Sdn. Bhd, Malaysia) in 15 mL of distilled water at 16,000 rpm for 20 s. The samples were centrifuged (Union 32R, Hanil Co., Ltd., Korea) at 3,000 rpm for 10 min, and then filtered through Whatman No. 1 filter paper (Whatman Ltd., England). Chloroform (10 mL) was added to the homogenates to remove fat, and the mixture was shaken 3 times. The mixture was then separated into lipids and aqueous supernatant by centrifugation (Union 32R, Hanil Co., Ltd., Korea) at 3,000 rpm for 10 min. The supernatant was used for the analysis of total phenolic content and α,α′-diphenyl-β-picryl-hydrazyl (DPPH) radical scavenging activity.

Total phenolic content

Total phenolic content was measured using the Folin-Ciocalteu method (Subramanian et al., 1965). A 0.1-mL aliquot was added to 0.2 mL Folin-Ciocalteu reagent and allowed to react for 1 min. Sodium carbonate (5%, 3 mL) was added to the mixture and vortexed. The mixture was then incubated at 23°C in the dark for 2 h. The absorbance was measured using a spectrophotometer (DU 530, Beckman Instruments Inc., USA) at 765 nm. The natural phenolics were quantified using a standard curve generated for gallic acid, and were expressed as gallic acid equivalents.

DPPH radical scavenging activity

DPPH radical scavenging activity was estimated according to the method described by Jung et al. (2010). A 0.2-mL aliquot was mixed with 0.8 mL distilled water.