Antioxidant Activity of Goldenrod (Solidago virgaurea) Leaf and Stem Powder on Raw Ground Pork during Chilled Storage

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Abstract

The effects of adding goldenrod leaf powder (GLP) and goldenrod stem powder (GSP) (0.1% and 0.5%) to raw ground pork on antioxidant activity were examined. The following six treatment groups were used: Control (without antioxidant), GLP1 (with 0.1% GLP), GLP2 (with 0.5% GLP), GSP1 (with 0.1% GSP), GSP2 (with 0.5% GSP) and AS (with 0.05% ascorbic acid). The chemical compositions, pH values, instrumental color, conjugated diene (CD), free fatty acids (FFA) and thiobarbituric acid-reactive substance (TBARS) value were measured during 15 d of storage at chilled temperatures. The addition of GLP and GSP showed no effect on moisture, protein and fat contents of the samples. However, adding 0.5% GSP increased the ash contents of ground pork (p<0.05). The pH values of treated samples decreased until day 7, and then increased thereafter. The addition of GLP and GSP decreased the L* and a* values and increased the b* value (p<0.05). The CD, FFA and TBARS value of the control were higher (p<0.05) than samples containing GLP and GSP. The addition of GLP and GSP resulted in a significant decrease in CD, FFA and TBARS values. Overall, this study demonstrated that GL and GS could be used as an antioxidant of raw ground pork.

Key words: goldenrod leaf powder, goldenrod stem powder, antioxidant activity, raw ground pork, chilled storage

Introduction

Lipid is a major nutrient in meat and has been reported to enhance the properties of meat product, including the flavor, tenderness, and juiciness (Linda, 2005). However, an excess of lipids can cause rapid lipid oxidation. Lipid oxidation is mostly initiated in the polyunsaturated fatty acids, leading to the production of free radical. Free radicals promote additional oxidation or decomposition to secondary reaction products such as aldehydes, ketones and other oxygenated compounds that produce adverse effects. As a result, lipid oxidation progress can significantly deteriorate the quality of meat products, such as an development of the rancid flavor, discoloration, loss of nutritional value, and limiting shelf-life (Frankel, 1950).

Several synthetic antioxidants have been used in the meat product industry to prevent lipid oxidation, including butylated hydroxytoluene (BHT), and butylated hydroxyanisole (BHA). These antioxidants were generally used because of their strong antioxidant activity and economic efficiency. However, several researches have reported that use of synthetic antioxidants may cause health risk (Chen et al., 1992; Sherwin, 1990; Sun and Fukushima, 1997). BHA was classified as group 2B by the International Agency for Research on Cancer and has been Regarded as a human carcinogen by National Institutes of Health. In addition, BHT has been shown to cause internal and external haemorrhaging in some experimental animals (Shahi and Wanasundara, 1992). For these reasons, there has been an increasing demand to decrease the use of synthetic antioxidants (Namiki, 1990) and an increase in the demand for natural antioxidants that display no toxicity and health risks. Recently, several natural antioxidants have been studied from plant. Plants contain lots of polyphenolic compounds, which have been extensively known to have antioxidant activity. McCarthy et al., (2001) studied the antioxidant activity from aloe vera, fenugreek, ginseng, mustard, rosemary, sage, tea catechins. In addition, Bandyopadhyay et al. (2008) studied natural antioxidant from viz. beet (Beta vulgaris), mint (Mentha spicata L.) and ginger (Zingiber
Goldenrod (*Solidago virgaurea*) is an herbaceous perennial plant that involves the family *Asteraceae*. Goldenrod contains abundant vitamins, such as vitamin A, β-carotene and various mineral as phosphorus, calcium and iron. Choi *et al.* (2010) reported that goldenrod has DPPH radical scavenging activity and antimicrobial activities. Starks *et al.* (2011) observed that goldenrod extract was a biosynthetic material that presented an antimicrobial effect called clerodane. Furthermore, Kim *et al.* (2011a) found that the goldenrod extract produced an anti-inflammatory effect.

Therefore, the objective of this study was to examine the effects of Goldenrod (*Solidago virgaurea*) leaf and stem powder on the oxidative stability of raw ground pork during over 15 d of storage at chilled temperatures.

**Materials and Methods**

**Preparation of goldenrod (*Solidago virgaurea*) leaf and stem powder**

The goldenrod were washed and cut to separate the leaves and stems. The leaves and stems were cut into small pieces, dried in a hot air dryer (Enex-Co-600, Enex, Korea) at 50°C for 15 h, and powdered (35 mesh). Goldenrod powders were stored at -18°C prior to the experiment.

**Preparation of meat samples**

Fresh pork hams and back fats were purchased from a pilot plant at Konkuk University, Korea, 48 h postmortem. All subcutaneous and intramuscular fat and visible connective tissues were removed from the fresh ham muscles.

The ground meat samples were produced using the following formulation: 73.5% lean pork meat, 20% pork back fat, 5% Ice, and 1.5% salt. The lean pork meat and pork back fat were ground through a 3 mm grinding plate and then ice and salt were added. The goldenrod leaf and stem powder were added according to the following formulation: Con (without antioxidant); GLP1 (with 0.1% goldenrod leaf powder); GLP2 (with 0.5% goldenrod leaf powder); GSP1 (with 0.1% goldenrod stem powder); and GSP2 (with 0.5% goldenrod stem powder); AS (with 0.05% ascorbic acid). These percentages were based on the formula weight of the ground meat samples without the antioxidant extract. Samples were hand mixed for 5 min. The mixed meat was then anaerobically packaged in PE/nylon film bags, spread to a thickness of 2.5 cm and, stored at 4±1°C for 15 d.

**Chemical compositions**

The chemical compositions of the samples were determined using standard AOAC (2000) methods. The moisture content was determined based on the weight loss after 12 h of drying at 105°C in a drying oven (SW-90D, Sang Woo Scientifict Co., Korea). The fat content was determined using the Soxhlet method with a solvent extraction system (Soxtec® Avanti 2050 Auto System, Foss Tecator AB, Sweden). The protein content was determined using the Kjeldahl method with an automatic Kjeldahl nitrogen analyzer (Kjeltc® 2300 Analyzer Unit, Foss Analytical AB, Sweden) and the ash content was determined according to the AOAC (2000) method.

**pH values**

The pH values of the samples were measured using a pH meter (Model 340, Mettler-Toledo GmbH, Switzerland). The pH of the raw ground pork was measured after blending 5 g of sample with 20 mL of distilled water for 60 s in a homogenizer (Ultra-Turrax SK15, Janke & Kunkel, Germany).

**Instrumental color**

The instrumental color analyses of the raw pork patties were conducted as follows. The color measurements were acquired using a colorimeter (Chroma meter CR-210, Minolta, Japan; illuminate C, calibrated with a white standard plate CIE L*=97.83, CIE a*=−0.43, CIE b*=+1.98), which consisted an 8 mm diameter measuring area and a 50 mm diameter illumination area. The color values (CIE L*, a*, and b*) were measured on the sample surfaces and data were collected in triplicate for each sample.

**Thiobarbituric acid reaction substance (TBARS) values**

Lipid oxidation was assessed in triplicate using the 2-thiobarbituric acid (TBA) assay described by Tarladgis *et al.* (1960) with minor modifications. Fifty mL of distilled water was added to 10 g of sample prior to homogenizing with a homogenizer (AM-7, Nihonseiki Kaisha Ltd., Japan) at 10,000 rpm for 2 min. The cup used for blending was washed with an additional 47.5 mL of distilled water, which was added to the same distillation flask containing 2.5 mL of 4 N HCl and a few drops of an anti-foam agent, silicone o/w (KMK-73, Shin-Etsu Silicone Co., Ltd., Korea). The mixture was distilled and 50 mL