Combined Effect of Kimchi Powder and Onion Peel Extract on Quality Characteristics of Emulsion Sausages Prepared with Irradiated Pork

Soo-Yoen Lee, Hyun-Wook Kim, Ko-Eun Hwang, Dong-Heon Song, Min-Sung Choi, Youn-Kyung Ham, Yun-Sang Choi¹, Ju-Woon Lee², Si-Kyung Lee³, and Cheon-Jei Kim*

Department of Food science and Biotechnology of Animal Resources, Konkuk University, Seoul 143-701, Korea
¹Food Processing Research Center, Korean Food Research Institute, Seongnam 463-746, Korea
²Team for Radiation Food Science and Biotechnology, Advanced Radiation Technology Institute, Korea Atomic Energy Research Institute, Jeongeup 580-185, Korea
³Department of Bioresources and Food Science, Konkuk University, Seoul 143-701, Korea

Abstract

This study was conducted to investigate the effects of kimchi powder and onion peel extract on the quality characteristics of emulsion sausage manufactured with irradiated pork. The emulsion sausages were formulated with 2% kimchi powder and/or 0.05% onion peel extract. The changes in pH value of all treatments were similar, depending on storage periods. The addition of kimchi powder increased the redness and yellowness of the emulsion sausage. The addition of onion peel extract decreased the thiobarbituric acid reactive substances value of the emulsion sausages prepared with irradiated pork. The volatile basic nitrogen value of the emulsion sausage prepared with kimchi powder was the highest, whereas that of the emulsion sausage prepared with onion peel extract was the lowest. The treatment without kimchi powder or onion peel extract and the treatments prepared with onion peel extract showed lower microbial populations than the other treatment. Sensory evaluations indicated that a higher acceptability was attained when kimchi powder was added to the emulsion sausages manufactured with irradiated pork. In conclusion, our results suggest that combined use of kimchi powder and onion peel extract could improve quality characteristics and shelf stability of the emulsion sausage formulated with irradiated pork during chilled storage.

Keywords: emulsion sausage, irradiation, kimchi, onion peel

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Introduction

Food irradiation is one of technologies for improving the shelf-stability of meat and meat products during storage. Irradiation, involving various chemical changes on microorganism, has indirect and direct effects. Indirect effects cause the destruction of deoxyribonucleic acid (DNA) molecule, and direct effects result in the formation of free radicals from water in the DNA surroundings (Molins, 2001). Although both effects lead to the inhibition of pathogenic microorganism growth, and extend shelf-life, irradiation can accelerate lipid oxidation and produce off-flavor in meat products (Ahn et al., 2000). To solve these problems in irradiated meat and meat products, many researchers have attempted to use natural antioxidants (Du et al., 2000; Ismail et al., 2008; Mohamed et al., 2011) and modify packaging method (Ahn et al., 1998; Ahn et al., 2001).

Kimchi is a traditional fermented food in Korea and contains vitamin C, carotene, and phenol compounds etc., and provides anticancer effects, hypertension prevention, and antioxidative effect (Lee et al., 2008). Kimchi has a specific flavor due to the presence of free amino acids, organic acids, and saccharide etc., which are produced during fermentation. For this reason, kimchi has been used to improve the flavor of meat products, and Lee et al. (2008) reported that the quality of meat products, including off-odor, was improved through the addition of kimchi, and the color of meat product was also affected by adding hot air dried kimchi powder. However, a number of previous studies have reported that kimchi acts as a pro-oxidant in some situations. Lee and Kunz (2005) reported that the effect of kimchi on lipid oxidation...
depends on its fermentation temperature. Choi (2012) reported that although kimchi powder masked the flavor and off-odor induced by irradiation, it also led to the acceleration of lipid oxidation in irradiated pork sausage. Also, Kim et al. (2014) reported that the combined use of kimchi powder and smoking technique could improve the quality characteristics and shelf life of cooked sausages formulated with irradiated pork.

The antioxidant activity of onion is widely known, and previous studies have reported that onion exerts an antioxidant effect due to its flavonol and phenolic content (Huber et al., 2009). Especially, the outer dry layer of onion showed the great antioxidative properties, because the concentration of quercetin, one of the flavonols in onion peel, is higher here than in others part (Prakash et al., 2007). Shim et al. (2012) reported that onion peel ethanol extracts inhibited the lipid oxidation of ground pork meat.

Therefore, the objectives of this study were to evaluate the effects of hot air dried kimchi powder and onion peel extract on the quality characteristics of emulsion type sausages formulated with irradiated pork, for improving shelf stability during chilled storage.

Materials and Methods

**Gamma irradiated meat preparation**

Fresh pork ham (Musculus biceps femoris, M. emidenti- nosus, M. semimembranosus) and back fat were purchased in a local market. All subcutaneous, intermuscular fat and visible connective tissue were removed from the fresh pork muscles. Trimmed muscles were ground through an 8 mm plate, after which the ground tissue was placed in polyethylene bags, vacuum-packaged using a vacuum packaging system (FJ-500XL, Fugee Tech, Korea) and stored -20°C until irradiation.

The meat was irradiated at 10 kGy in a cobalt-60 irradiator (point source, AECL, IR-79, Nordion international, Canada) with source strength of 100 kCi in Advanced Radiation Technology Institute of Korea Atomic Energy Research Institute (Korea). The dose rate was 10 kGy/h at 18±0.5°C. Dosimetry was performed using 5 mm diameter alanine dosimeters (Bruker Instruments, Germany), and the free-radical signal was measured using a Bruker EMS 104 EPR Analyzer. The actual dose was within ±2% of the target dose. The irradiated ground pork meat was transferred to a refrigerator and stored until required for product manufacture within 3 d.

**Preparation of onion peel extract and kimchi powder**

Onion peel extract was prepared as described by Shim et al. (2012). Onions were obtained from a local market. The onions were washed, the onion peels were dried for 8 h at 50°C in a hot air drier (Enex-CO-600, Enex, Korea), powdered (35 mesh), and stored in polythene bags at 4°C. Dried onion powder was extracted with 50% ethanol overnight on a shaker at room temperature. The extract was filtered through filter paper (Ø110 mm, No. 1, Whatman Inc., UK) and evaporated with a rotary evaporator (EYELA N-1000, Rikakikai Co. Ltd., Japan) below 55°C. After evaporation the ethanol, the onion peel ethanol extracts were dissolved in distilled water to adjust identical solid concentration in extract (5 mg/mL). Commercial Chinese cabbage kimchi was purchased from a local market (Chongga Kimchi, Daesang FNF, Korea). Kimchi powder was prepared with the method of Lee et al. (2008) and stored in a 4°C refrigerator until manufacturing sausage.

**Manufacturing of emulsion type pork sausage**

Emulsion type pork sausages were manufactured with following formulation: 60% lean pork meat, 20% pork back fat, 20% ice water, nitrite pickled salt (NPS, 1.5%), sodium tripolyphosphate (0.3%), monosodium l-glutamate (0.06%), onion powder (0.3%), garlic powder (0.3%). Control treatment was manufactured with non-irradiated pork meat and the other treatments were manufactured with irradiated pork meat. Control and IR treatments were prepared without onion peel extract or kimchi powder. IRO treatment contained 0.05% onion peel extract and IRK treatment contained 2% kimchi powder. IROK treatment contained both 0.05% onion peel extract and 2% kimchi powder. Meat, fat, water and other ingredients were emulsified using a silent cutter (Nr-963009, Scharffen, Germany). After emulsification, the meat batter was stuffed into collagen casings (#240, NIPPI Inc., Japan; approximate 25 mm diameter) using a stuffer (IS-8, Sirman, Italy), and then were heated at 80°C until 75°C at core temperature for 30 min in smoke house. The cooked sausages were cooled and vacuum-packaged. All samples were stored in a 4°C refrigerator until use.

**pH measurement**

The pH values of cooked samples were determined with a pH meter (Model 340, Mettler-Toledo GmbH, Switzerland). The pH values were measured by blending a 5 g sample with 20 mL distilled water for 1 min in a homogenizer (Ultra-Turrax T25, Janke & Kunkel, Ger-