Effects of Rice Bran Fiber on Changes in the Quality Characteristics of Raw Ground Pork during Chilled Storage

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Abstract

Ground pork containing 0, 1, 2, or 3% rice bran fiber was prepared. pH increased as the amount of rice bran fiber added increased (p<0.05) but decreased during storage. The lightness and redness values of the raw ground pork decreased with the addition of rice bran fiber, and ground pork containing 3% rice bran fiber had the highest yellowness value during early storage (p<0.05). Moreover, adding rice bran fiber was not associated with color stability during storage. Samples containing 2 or 3% rice bran fiber had improved cooking loss, hardness, gumminess, and chewiness. Furthermore, rice bran fiber enhanced tenderness, juiciness, and overall acceptability on a sensory evaluation. These physico-chemical properties were maintained to the final storage period. The best results were obtained with ground pork containing 2 or 3% rice bran fiber. Rice bran fiber combined with useful antioxidants may be a more effective approach to increase the stability of ground pork during cold storage.

Key words: rice bran fiber, dietary fiber, ground pork, chilled storage

Introduction

Recently, consumers that value the importance of health have been demanding functional and healthy meat products. Functional meat and meat products are respectively manufactured by feeding functional material to livestock or by adding functional source to meat products with the aim of satisfying the needs of these consumers in regards to making low-fat and low-calories meat products (Jimenez Colmenero, 2000; Yang et al., 2002; Youssef and Barbut, 2011). These functional materials, mainly obtained from plants, have positive effects when added to meat and one of these functional materials is dietary fiber. Dietary fibers are derivatives that are not digested by enzymes in the human body and include oligosaccharides, polysaccharides, and lignin (Lim et al., 2004). The positive physiological effects of these materials are already well known, especially in the meat processing industry, the addition of dietary fiber to meat products improves the binding properties of raw meat, emulsion stability, and mineral holding capacity (Lim et al., 2004; Thebaudin et al., 1997). The dietary fibers used on meat products are typically husk group such as rye bran, oat bran, and wheat bran and vegetable group (Garcia et al., 2002; Yilmaz and Dagliglu, 2003; Yilmaz, 2004; Yilmaz, 2005). These previous studies have examined the ability of dietary fibers to improve the quality characteristics of meat products; however, no study has examined the effect of dietary fibers on changing the quality characteristics of ground pork products during storage periods.

One potential source of dietary fiber is rice bran fiber, which is made by rice polishing. In Korea, the amount of rice bran fiber produced annually ranges from 400,000-500,000 tons (Choi et al., 2008). This rice bran has a high lipid content which can cause lipid oxidation; however, approximately 20-25% of this rice bran consists of dietary fibers (Lee and Shin, 2006). Interestingly, pre-processed rice bran (through removal of fat etc.) has been used to improve the quality of various meat products. Previous studies have examined many aspects of rice bran including: 1) the effects of rice bran fiber on the quality characteristics of various meat products (Choi et al., 2008; Huang et al., 2005), 2) the utilization of a fat

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replacer (Choi et al., 2009; Choi et al., 2010). Most of these studies examined the effect of adding 1-3% rice bran fiber levels. Consumers usually consume commercial meat products after the product has been distributed and stored rather than consuming it directly after manufacturing; therefore, there is a need to examined the effect of dietary fibers on the quality characteristics of meat products during storage.

Therefore, we evaluated changes in the physicochemical and sensorial properties of ground pork containing various concentrations of rice bran fiber. Our results provide important data for consumers and researchers interested in meat products containing dietary fiber, especially for products containing rice bran fiber.

Materials and Methods

Preparation and processing of rice bran fiber

The rice bran (Japonica rice cultivar, *Oriiza sativa* L.) was purchased from a market in Geochang, Korea. It was ground in a mill, to pass through a 25 mesh sieve, roasted at 105°C and defatted with hexane (n-hexane 95%) in a shaker (BS-11, Lab. Companion, Korea) overnight. The defatted rice bran was treated with 0.6% termamyl (heat stable alpha-amylase) at 95°C for 1 h to remove starch, followed by filtration. The resulting residue was washed three times with four volumes of hot water (100°C), allowed to equilibrate at room temperature (20°C, 6 h) then washed with 99.9% ethanol (preheated to 60°C), followed by filtration. The resulting residue was dried (55°C) overnight using an air oven and cooled. The rice bran fiber was placed in polyethylene bags, vacuum sealed using vacuum packaging system (FJ-500XL, Fujee Tech., Korea), and stored at 4°C until used. The chemical and physical properties of rice bran fiber is as follows; moisture (11.73±0.32 mg/100 g), protein (21.91±0.43 mg/100 g), fat (4.31±0.43 mg/100 g), ash (7.42±0.24 mg/100 g), digestible carbohydrates (1.38±0.18 mg/100 g), dietary fiber (53.25±0.79 mg/100 g), pH (7.07±0.04), and color parameters (CIE L*, 66.10±0.20; CIE a*, 4.73±0.04; CIE b*, 16.06±0.06) (Choi et al., 2011).

Manufacturing of ground pork

Fresh pork meats were purchased from a local processor at 48 h postmortem. Pork back fat was also collected. All subcutaneous and inter-muscular fat and visible connective tissue were removed from the fresh ham muscles. Lean muscles and pork back fat were initially ground through Ø-8 mm plate using a meat grinder (PM-70, Mainca, Spain). The ground meat and fat were packaged with Nylon/PE film bags, and stored at 4°C.

All samples were composed by 80% pork ham (*M. biceps femoris*, *M. semitendinosus*, and *M. semimembranosus*), 15% pork fat, 5% ice water and 1.5% NaCl. The mixtures from each batch were mixed by hand for 5 min. Each batch of samples consisted of four samples, which differed in composition with respect to rice bran fiber levels (0, 1, 2, and 3%). Mixed samples were packaged with Nylon/PE film bags, stored in a refrigerator (4°C) for 15 d and evaluated after 0, 3, 6, 9, 12, and 15 d of storage periods.

pH measurements

The pH values of samples were determined with a pH meter (Model 340, Mettler-Toledo GmbH, Switzerland). The pH values of samples were measured by blending a 5 g sample with 20 mL distilled water for 60 s in a homogenizer at 8,000 rpm (Ultra-Turrax SK15, Janke & Kunkel, Germany).

Instrumental color evaluations

The instrumental color analysis of ground pork was conducted. Color measurements were taken with colorimeter (Chroma meter CR-210, Minolta, Japan; illuminate C, calibrated with white standard plate CIE L’=97.83, CIE a’=−0.43, CIE b’=+1.98), consisted of an 8 mm diameter measuring area and a 50 mm diameter illumination area. Color values (CIE L’, a’, and b’) were measured on the surface of samples and results were taken in triplicate for each sample.

Cooking loss

Cooking loss was determined by calculating the weight differences before and after cooking as follows. All samples evaluated after at 0, 3, 6, 9, 12, and 15 d of storage.

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\text{Cooking loss (\%)} = \frac{\text{weight of raw sample (g)} - \text{weight of cooked sample (g)}}{\text{weight of raw sample (g)}} \times 100
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TBA (2-thiobarbituric acid) values

Lipid oxidation was assessed in triplicate by the TBA (2-thiobarbituric acid) method of Tarladgis et al. (1960) with minor modifications. A 10 g sample was blended with 50 mL distilled water for 2 min and then transferred to a distillation tube. The cup used for blending was washed with an additional 47.5 mL of distilled water, which was added to the same distillation flask with 2.5