INFLUENCE OF PACKAGING METHOD ON THE LIPID AND PROTEIN DETERIORATION OF PRECOOKED KOREAN BEEF BULGOGI

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Abstract – The influence of packaging method (Air package, AP; High oxygen-modified atmosphere package, HOx-MAP; Low oxygen-modified atmosphere package, LOx-MAP) on the lipid and protein deterioration of precooked Korean beef BULGOGI at 4℃ for 14 d was investigated. AP and LOx-MAP retained the total reducing ability and inhibited the formation of TBARS. However, both HOx-MAP and LOx-MAP increased the free amine and volatile basic nitrogen. It is concluded that HOx-MAP decreased the lipid oxidation stability in precooked BULOGOGI during storage and both MAP decreased the protein oxidation stability.

Key Words – Air package, High oxygen-MAP, Low oxygen-MAP, BULGOGI, Precooked

I. INTRODUCTION

The BULGOGI, Korean traditional beef product, is one of the most famous Korean dishes with KIMCHI all over the world. As the BULGOGI (in Korean) means the Fire (BUL) Meat (GOGI) in English, originally, it has been prepared by grilling the sweet-seasoned beef. Nowadays, the spicy-seasoned-grilled pork is also referred to as the BULGOGI (Pork BULGOGI).

Undoubtedly, modified atmosphere package (MAP) could be the most advanced technology in meat packaging. Among various types of MAP, high oxygen-containing MAP (70-80% O_2/20-30% CO_2) is advantageous to suppression of growth of microorganisms and betterment of color stability in raw meat (1). But it seriously deteriorates the quality of the meat with acceleration of lipid and protein oxidation (2).

In Korea, recently, meat industry is trying to apply the display package to precooked and seasoned meat products because of increase of consumer demand that purchase simply those like case-ready packaged fresh meat. However, little information on effect of packaging method on the convenient meat products in display has been reported.

Therefore, the present study was carried out to investigate the influence of packaging method on the lipid and protein deterioration of precooked Korean beef BULGOGI during storage, in order to find the suitable package for it.

II. MATERIALS AND METHODS

A. Preparation of BULGOGI and design

The chuck roll (60%) imported from Australia were sliced into 1.5 mm thickness with a frozen meat cutter, mixed with 37% of seasoning (69.7% water, 14.94% soy sauce, 7.11% sugar, 5.12% onion, 2.56% garlic, 0.31% salt, 0.17% black pepper, and 0.09% MSG) and 3% of gelatin powder, wet-heated in a steam-cooker, and then cooled. The BULGOGI samples were placed onto polystyrene barrier foam trays (Cryovac Sealed Air Corp., Duncan, SC, USA), flushed either with air (AP), 0% O_2/20% CO_2/80% N_2 (LOx-MAP), and 80% O_2/20% CO_2/0% N_2 (HOx-MAP), and sealed with O_2 barrier films (Cryovac Sealed Air Corp., Duncan, SC, USA). All packs were stored for 14 d at 4℃.

B. TRA analysis

Total reducing ability (TRA) was analyzed according to the procedure slightly modified by Seyfert *et al*. (3). Two grams of samples were mixed with 10 mL of 25 mM pipes buffer (pH 5.8) by a Polytron homogenizer (PT-MR 2100, Kinematica AG, Littau, Luzern, Switzerland) for 30 s. After incubation with potassium ferricyanide (PF; 5 mM) for 60 min at 4℃ under the dark, the homogenates were reacted with ammonium sulfamate, lead acetate, and TCA (0.4 mM, 10

mM, and 5% (w/v): final concentrations). The final mixtures were centrifuged (Avanti J-20XP Centrifuge, Beckman Coulter, Inc., Palo Alto, C.A., U.S.A.) for 10 min at 3,000 × g at 2℃ before filtering through 0.45 μm syringe filter, and then spectrophotometrically (ProteomeLab DU-800, Beckman Coulter, Inc., Fullerton, CA, USA), measured at 420 nm. The results were expressed as absorbance value of blank (1 mM PF) minus absorbance values of samples.

C. TBARS measurement

The 2-thiobarbituric acid reactive substances (TBARS) content was analyzed following the method previously reported by Sinnhuber & Yu (4). The samples (0.5 g) were combined with 3 drops of antioxidant solution (54% (w/w) propylene glycol-40% (w/w) Tween 20-3% (w/w) BHT-3% (w/w) BHA), 3 mL of 1% (w/v) TBA-0.3% (w/v) NaOH, and 17 mL of 2.5% (w/v) TCA-36 mM HCl, boiled (30 min), and then cooled on ice. The supernatants were measured at 532 nm, following centrifugation (Avanti J-E Centrifuge, Beckman Coulter, Inc., Palo Alto, CA, USA) for 30 min at 3,000 × g at 4℃. The results were expressed as mg of malonaldehyde (MA) per kg of sample.

D. Free amine measurement

Free amine content was analyzed using the method established by Snyder & Sobocinki (5). Two grams of samples were homogenized (T25 Digital Ultra-Turrex, Ika Werke GmbH & Co., Staufen, Baden-Wüttenberg, Germany) with 20 mL of 0.15 M KCl for 30 s and filtered through Whatman filter paper No. 1. Immediately after addition of 30 mM 2,4,6-trinitrobenzenesulfonic acid (in 0.1 M sodium tetraborate buffer, pH 9.3), the filtrates were incubated for 30 min at 25℃. The absorbance values were recorded at 420 nm and calculated as μmol free amines per kg of sample through molar extinction coefficient (13,200 $M^{-1}cm^{-1}$) of glycine.

E. VBN determination

Volatile basic nitrogen (VBN) content was determined on triplicate by the Conway method of Kohsaka (6). In Conway dishes, the filtered sample mixtures (Sample : DW = 1 : 9; 1 mL) were incubated with borate buffer (Containing bromocresol green and methyl red; 1 mL) and 50% (w/v) K_2CO_3 (1 mL) for 90 min at 37℃ and then neutralized with 0.02 M H_2SO_4. The results were expressed as mg N per 100 g of sample.

F. Statistical analysis

All data were analyzed by SPSS (7) program. Duncan's multiple range tests were carried out to evaluate the significant differences among means at $P < 0.05$.

III. RESULTS AND DISCUSSION

The effect of packaging method on the total reducing ability (TRA) of precooked Korean beef BULGOGI at 4℃ for 14 days was presented in Figure 1. From 5 days of storage, TRA of BULGOGI stored with air package (AP) and low oxygen-modified atmosphere package (LOx-MAP) was significantly ($P < 0.05$) higher than high oxygen-modified atmosphere package (HOx-MAP). This result was similar with Seyfert *et al*. (3) who have reported that TRA was higher in beef steak displayed with 80% O_2/20% CO_2–MAP at day 7 compared with 20% O_2/20% CO_2–MAP.

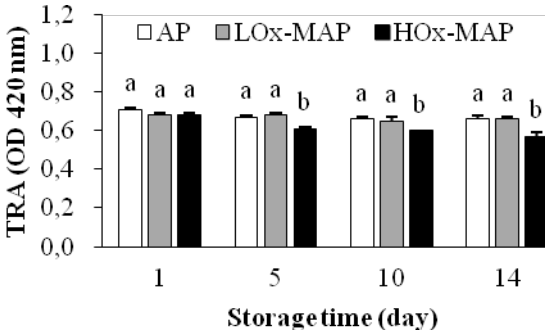

Figure 1. Effect of packaging method on the total reducing ability (TRA) of precooked Korean beef BULGOGI at 4℃ for 14 days. [a-b]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$).

The effect of packaging method on the TBARS content of precooked Korean beef BULGOGI was presented in Figure 2. The BULGOGI stored with AP and LOx-MAP had significantly ($P < 0.05$) lower TBARS content than HOx-MAP from 10 days of storage. Similarly, in a study of Muhlisin

et al. (8), it has also been reported that TBARS content lowered in beef patties packaged with air and 100% N_2 compared with 70% O_2/30% CO_2 during chilling storage.

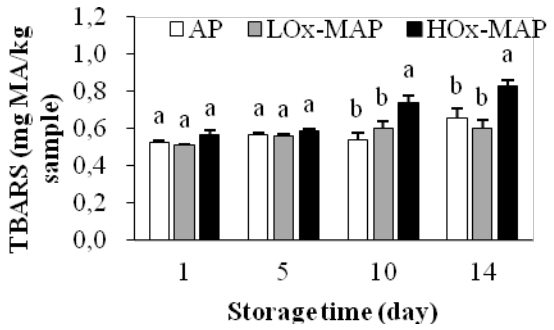

Figure 2. Effect of packaging method on the TBARS content of precooked Korean beef BULGOGI at 4℃ for 14 days. [a-b]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$).

As an index of protein oxidation, free amine content (Figure 3) was significantly ($P < 0.05$) lower in BULGOGI stored with AP than in both MAP at day 14. This might be because CO_2 promoted the protein oxidation.

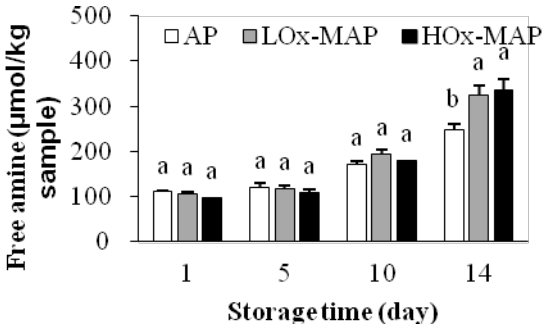

Figure 3. Effect of packaging method on the free amine content of precooked Korean beef BULGOGI at 4℃ for 14 days. [a-b]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$).

The volatile basic nitrogen (VBN), another compound developed by deterioration of protein, was significantly ($P < 0.05$) lower in BUGOGI stored with AP compared with both MAP from 5 days. During storage, the change of VBN content in BULGOGI was similar with free amine content.

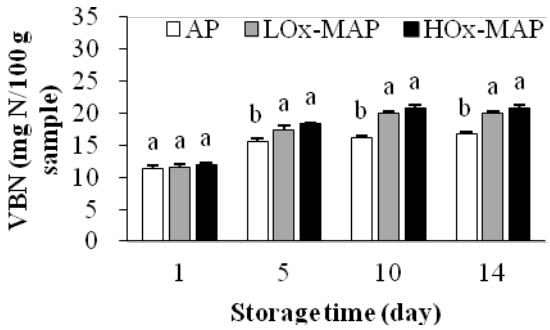

Figure 4. Effect of packaging method on the volatile basic nitrogen (VBN) content of precooked Korean beef BULGOGI at 4℃ for 14 days. [a-b]Means±S.E. among treatments with different letters differ significantly ($P < 0.05$).

IV. CONCLUSION

High concentration of oxygen in MAP accelerated the deterioration of lipid in stored-precooked BULGOGI. In addition, carbon dioxide promoted the protein deterioration.

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