PE8.18 Effects of ascorbic acid, sodium acetate and calcium lactate, and chitosan on the case-ready packed ground beef and pork patties 166.00

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Abstract The effects of ascorbic acid (AA) and/or in combination with sodium acetate/calcium lactate (AA+SACL) and chitosan (AA+CH) on the beef and pork patties stored at 5° were investigated. The patties were case-ready packed in an air-containing polypropylene (PP) tray. The treatments of AA, AA+SACL and AA+CH were effective for inhibiting the total aerobic bacteria compared with the control from the day 6. TBA (thiobarbituric acid) and VBN (volatile basic nitrogen) values were lower and a* (redness) values and the sensory scores for the surface colour and off-odour attributes were higher in the treated samples than the control until day 8. In view of maintaining quality and shelf-life extension, AA+SACL samples gave the most desirable results among the treatments.

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I. INTRODUCTION

Meat patties are susceptible to quality changes due to the oxidation and the microbial growth compared to intact muscle cuts, by exposing more surface to air and microbial contamination after grinding. The development of metmyoglobin and rancidity caused by an oxidation process would be the detrimental factors for the rejection of ground meat patties by consumers. Therefore, up to recently, diverse attempts have been made to improve the problems related to oxidation and microbial growth in meat patties [1-2]. In this connection, meat product manufacturers tend to increasingly use natural additives like organic acids including ascorbic acid, lactic acid and acetic acid or their salts, which are preferred by consumer owing to safety awareness. It was reported that 0.05% ascorbic acid treatment in ground beef was adequate to retard discolouration and rancidity at least for 5 days [3]. Therefore, the use of ascorbic acid can be basically recommended in the recipe of the meat patties when considering its price, nutritional value and antioxidant effects. Furthermore, it will be interesting to examine the use of chitosan for meat products because of its useful effects on the antibacterial, antioxidant and other functional properties. Currently for marketing patties in Korea, ground meats are generally delivered to the retail stores after vacuum packaging and formed on-site into patties for sale. However, case-ready (CR) packaging becomes increasingly important in order to assure the hygiene and the traceability of the meat products. Differently from the USA and EU countries, the market of ground CR packed patties in the modified atmosphere is not yet common in Korea, probably because of its high invest and operation costs. Besides, due to the recent worldwide economical crisis, the local producers of patty products are trying to reduce production costs, for example, by substituting the beef partly for the cheap pork. However, the effect of antioxidant and antimicrobial additives on the beef and pork mixed patties has not been examined enough [4]. In this study, therefore, we examined the effects of several organic acid and salts, and chitosan on the quality and shelf-life of beef and pork patties during chilled storage packed in an air-containing PP tray as a CR packaging, considering the balance between processing cost and shelf-life prolonging effect.

II. MATERIALS AND METHODS

Vacuum packaged frozen beef (chucks) was thawed and ground through a 8 mm hole plate by meat grinder (622, Mado Co., Switzerland). Vacuum packaged fresh pork (hams) was ground through a 3 mm hole plate. Ground beef and pork (ratio: 3:2 (w/w)) were thoroughly mixed in a vacuum mixer (Thematec Food Ind., Co., Korea) after adding additives and spices. 5 kg of ground meat products was then vacuum packaged in a nylon/polyethylene laminated pouch. 25 kg sample meat in 5 pouches was then transferred in an ice-box (ICDC-260, Olivo, France) maintained at +1°C for approximately 4 hrs to the laboratory. The samples were allocated to 5 treatments as following: (i) control (CON) added only with salt, phosphates, spices and

seasonings, (ii) T-1 (AA): (i)+ascorbic acid 500 ppm, (iii) T-2 (AA+SACL): (ii)+sodium acetate 1,500 ppm+ calcium lactate 500 ppm, and (iv) T-3 (AA+CH): (ii)+chitosan 7,000 ppm. The ground meats were formed in a 150 g patty with a circular template (d=10.0 cm and 1.8 cm in depth) and wrapped with a 30 ¦Ìm thick low density polyethylene film (LDPE) (O2 permeability: 4,730 cc/m2/day/atm at 23°C). Then, a patty was placed on a 365 ¦Ìm thick PP tray and sealed with polyethylene terephthalate (PETP)/cast polypropylene (CPP) laminated film (12/40 ¦Ìm, O2 permeability: 92 cc/m2/day/atm at 23°C). Packaged patties were stored in a dark at 5°C for 10 days and were analyzed periodically at every 2 days. Total aerobic bacteria (Standard-1 agar, Merck), Pseudomonas spp. (GSP agar, Merck), lactic acid bacteria (MRS agar, Merck) and coliform bacteria (3M) were determined during storage of patties. 10 g of sample was cut off from the side of a patty and mixed for 3 min in the Stomacher (Stomacher 80, Seward Medical, UK) after adding 90 mL of 0.1% sterilized peptone-water. The procedure for inoculation and incubation was followed according to the method of Lee and Yoon [5]. Hunter L* (lightness), a* (redness), b* (yellowness), and hue (arc tan b/a) values were measured for the surfaces of raw patties using a CR-300 Chroma Meter (Minolta Co., Japan). pH was measured using a combined glass electrode (720A, Orion, USA).

Changes in the TBA were used to assess lipid oxidation [6]. The VBN test using the microdiffusion technique was used to determine proteolytic degradation [7]. Gas composition (O2, N2 and CO2) in the headspace of the package was monitored by using a gas chromatography (7890A, Agilent Technologies, Germany) attached with a TCD detector and a Supelco Carboxen-1000 column. A trained, 8-10 member panel composed of faculty member and students of Gangnung-Wonju Univ. evaluated raw patty samples by using a 9-point hedonic scale for discolouration (9, no, to 1, total) and off-odour (9, no, to 1, extreme). Data were analyzed by using SAS statistical package. Furthermore, Duncan's multiple range test was used to compare means and significance which was established at $P<0.05$.

III. RESULTS AND DISCUSSION

Table 1 shows the microbiological changes of beef and pork patties stored at 5°C. The total aerobic plate count (TPC) was initially 4.81 log cfu/g which increased steadily with the storage and reached near the level of 8.0 log at day 8 and 10 in the control and the treated samples, respectively. The antimicrobial effect of ascorbic acid on the ground meat is controversial [8-9]. In our experiment, however, the addition of 500 ppm ascorbic acid showed an antimicrobial effect. Significantly lower TPCs in the AA+SACL samples were measured at day 4, 8 and 10 than in the AA and AA+CH samples. Increasing trends over the storage period were also observed for lactic acid bacteria (LAB), Pseudomonas spp. and coliforms in all samples. The dominant flora was LAB during the whole storage time, while the growth of Pseudomonas spp. was a little inhibited and coliforms distinctly, probably by LAB. The count of coliforms didn't exceed the level of 3.0 log cfu/g in all samples after 10 days. Changes in pH, TBA, and VBN values during storage of beef and pork patties are shown in Table 2. The pH values in all samples decreased gradually during storage and reached to 4.7-5.0 after 10 days. This might be associated mostly with the increase of LAB counts during storage. The pH of ascorbic acid solution used was low enough (approx. 1.7) to influence the water holding capacity of raw meat, but pH values of samples added with ascorbic acid except in AA+CH samples were not significantly different from the control. pH values of AA+CH samples were higher than the other samples until the day 6. TBA values increased significantly in the control compared with other treatments, from 0.114 mg MA/kg of day 0 to 0.338 mg MA/kg at the end of storage. Among the treated samples, there were no significant differences observed in the TBA values over the storage. Therefore, the use of acetate/lactate or chitosan in addition to 500 ppm ascorbic acid seemed not to have any synergistic effect on the lipid retardation compared to the use of ascorbic acid only. All samples seemed not to be deteriorated by rancidity, when considering the report that rancid flavour is initially detected in meat products with TBA values between 0.5 and 2.0 [10]. VBN value was in the control samples initially 5.1 mg%. However, it increased linearly with storage time and reached to 29.4 mg% at day 10. In the comparison, the VBN values of all of the treated samples were significantly lower than the control. Notably, the VBN values of AA were significantly lower than the other treated samples from the day 6. The color changes during storage are presented in Table 3. The a* values in all samples showed a decreasing trend, while hue values increased as the storage extended. Hue values are known to be

attributed to the oxidative accumulation of metmyoglobin with time [11]. The a* and hue values of the control became to be significantly low from the day 4 compared with the treated samples. Among the treated samples, AA+SACL and AA+CL samples showed a better color retention compared to AA samples from the day 6. Oxygen concentration in the headspace of package was initially 19.5% which was then gradually decreased below 10.0% after 10 days. Instead of the oxygen depletion, carbon dioxide concentration increased dramatically at the end of storage (data not shown). The increase of carbon dioxide in the meat package was attributed partly to the interactions of gas solubility, temperature, headspace volume, and microflora activity [12]. Table 4 shows a comparison of the sensory quality changes of patties during storage. The colour scores of the treated samples were slightly higher than the control over the storage period. Among the treated samples, AA+SACL samples were evaluated to get deteriorated slowly compared with the AA samples. Off-odour scores for the control samples became to be significantly lower than the treated samples from the day 8. Among the treated samples, AA+SACL samples were evaluated to have the least off-odour score. When assessing the sensory evaluation scores below 5.0 as losing the market value of the product, only the AA+SACL treatment could preserve the market quality until day 8.

IV. CONCLUSION

It was possible to extend the shelf-life of beef and pork patties by addition of ascorbic acid only or in combination with acetate/lactate salts and chitosan for 2 days compared with the control. The effect for retarding the discoloration was most pronounced in the AA+SACL added samples. However, the decision for the use of appropriate additives to the beef and pork patties could be made based on the cost and benefit calculation.

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