

Quality characteristics of beef rib eye roll wet-aged in a microwave aging chamber

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Abstract: This study used microwave (MW) heating to investigate whether increasing the internal temperature of beef to 10°C and maintaining a cooler surface environment (0°C) could accelerate the rate of beef aging. Rib eye rolls obtained four days postmortem were wet-aged in the control group for 17 days at 4°C. MW treatment for 6 d was performed with MW irradiation using PID- controlled by a maximum of 50 W. There was no difference in bacterial counts on the surface of the beef between the control and MW-treated groups. The proximate composition and meat quality-related items, including beef toughness (WBSF), were not significantly different between the two groups. However, the MW-treated group showed fewer 30 kDa bands and free amino acids than the control group. Therefore, the 6-day MW treatment was not equal to the 21-day wet aging, but the MW treatment may have slightly accelerated the aging of beef.

Objectives: Generally, sufficient meat quality characteristics can be obtained during 14-21 days of beef aging. Wet aging, which is performed in a vacuum-packed state, is the most common method of aging. Changes in meat tenderization during aging are thought to be related to endogenous enzymes, such as calpain and cathepsin. It is expected that favorable quality characteristics can be obtained in a shorter aging period than before for more cost-effective condition control. Microwave (MW) heating has vast applications in the field of food processing including drying, pasteurization, sterilization, thawing, tempering, and baking (Chandrasekaran et al., 2013). If the internal temperature of the beef can be raised to approximately 10°C in strictly controlled MW heating and the outside of the beef kept at a cooler temperature, meat tenderization may be shortened by promoting the endogenous enzymatic re- action. This study examined the effects of MW aging on beef quality and microorganisms in meat.

Materials and Methods: The experiment was conducted on 6 rib eye rolls obtained from Holstein Friesian Steers (n=3) four days after slaughter at the age of 20.3 ± 0.5 months. Rib eyes from the right-side of carcasses were used as the control group, and those from the left as the MW-treated group. The control group were wet-aged for 17 days at 4°C. MW treatment had irradiation using PID-controlled by a maximum of 50 W by an Aging booster (Shikoku Instrumentation Co. Ltd., Kagawa, Japan), followed by wet aging for six days at an internal temperature of 10°C and 0°C for the surface temperature.

The analysis items were proximate composition (moisture, crude protein, crude fat, ash, and carbohydrate), surface bacterial count (total plate count [TPC], coliform group), physical properties (Warner-Bratzler shear force [WBSF], cooking loss, expressible drip loss), instrumental color value (CIE L*, a*, b*), pH, myoglobin content, total collagen content, free amino acids, and sodium do- decyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) analysis of myofibrillar proteins.

Results and Discussion: The numbers of TPC on the surfaces of the MW treatment and control groups were 6.9 x 10³ cfu/cm² (n=3) and 4.6 x 10⁴ cfu/cm² (n=3), respectively, with no significant difference between them, similar to the coliform groups. An internal temperature of 10°C did not increase surface bacteria number. In proximate composition, moisture ranged from 61.86 to 70.32 g/100 g, crude protein ranged from 18.33 to 22.09 g/100 g, crude fat ranged from 6.31 to 17.07 g/100 g, and ash ranged from 0.85 to 1.03 g/100 g. There was no difference in proximate composition between the groups. There were no significant differences in the instrumental color values for lightness (L*), redness (a*), and yellowness (b*) between the control and MW-treated groups. The WBSF in the control group was 2.18 ± 0.85 kg/cm² and in the MW-treated group was 1.9 ± 0.16 kg/cm², with no significant difference between the groups. Cooking loss and expressible drip loss were also not significantly different between the groups. The pH of both groups ranged from 5.41 to 5.57, indicating a normal pH range. Myoglobin (mg/g) and total collagen (g/100 g) were not significantly different between the two groups. The total free amino acid content in the MW-treated group (165.31 mg/100 g) was significantly lower than that in the control group (245.79 mg/100 g) (P<0.05). Since the appearance of a 30 kDa band is an indicator of meat tenderization, myofibrillar proteins were examined by SDS-PAGE analysis, which showed that the intensity of the 30 kDa band in the MW-treated group was weaker than that in the control group. The appearance of 30 kDa bands and total free amino acid content suggests that MW treatment for 6 days might not accelerate protein degradation compared to 17 days of wet aging. However, WBSF, a measure of hardness and meat quality, was unaffected. Based on these results, MW treatment may slightly accelerate aging without affecting meat quality.

Key words: Microwave-heating, Wet-aging, Aging acceleration, Meat quality, Myofibrillar protein