Effect of radiofrequency tempering combined with conventional thawing on water-holding status and sensory attributes of chicken breast fillets

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Background: Apart from its relatively low price, benefits such as fewer religious restrictions, ease of cooking, and superior nutritional values related to relatively high contents of easily absorbed proteins and polyunsaturated fatty acids and low fats make chicken meat as one of the more popular protein sources; nevertheless, fresh chicken meat is highly perishable and has a limited shelf life even under refrigeration. Frozen storage is widely used to extend shelf life and maintain qualities of meat. Frozen meat must be defrosted before consumption or further processing. Frozen meat quality depends on freezing conditions and thawing methods. Some changes such as water loss, protein denaturation, lipid peroxidation, textural changes, color and flavor deteriora- tion, and microbial spoilage may occur during thawing. It is critical to maintain quality and minimize losses when considering suit- able thawing methods. Thawing technologies are widely applied in the meat industry, while radio frequency (RF) processing has been used for tempering frozen food.

Objective: The aim of this study was to evaluate the influence of RF tempering combined with conventional thawing on water-hold- ing status and sensory attributes of chicken breast fillets.

Materials and Methods: Skinless and boneless chicken breast fillets individually vacuum-packed in polyethylene bags were ob- tained from a meat processing plant, and randomly allocated to the five groups including fresh without frozen (FM, control group), water immersing thawing (WI, water temperature at 20ºC), air convection thawing (AC, temperature at 20ºC), RF (50 kW, 27.12 MHz) tempering combined with WI thawing (RFWI, RF and then WI thawing at 20ºC), RF tempering combined with AC (RFAC, RF and then AC thawing at 20ºC). FM was analyzed immediately while the remaining groups were frozen at -18ºC, and thawed by the abovementioned methods. Thawing was terminated as the sample core temperatures reached 4ºC. The thawing time, water- holding capacity of the samples which were expressed in terms of thawing, drip, centrifugation, and cooking losses, moisture con- tent, and sensory characteristics were determined according to the methods of Kaewkot et al. (2022). Shear force was determined according to the methods of Zhu et al. (2020).

Result and Discussion: The results showed that the thawing time of WI, AC, RFWI, and RFAC were 75, 160, 60, and 95 min, respectively. The time difference could be explained by the different heat transfer rates in the heat convection and conduction of air versus water. On the other hand, RF, which uses alternating currents to change the magnetic fields rapidly to excite polar molecule vibration thus produces heat within the frozen foods accordingly, probably penetrates more deeply and uniformly into frozen materials when comparing with air convection and water immersion thawing, eventually shortened the thawing time. AC had significantly ($P < 0.05$) higher thawing loss, drip loss, centrifugation loss, cooking loss, and shear force value as well as lower moisture content among all treatments ($P < 0.05$). Compared to FM, WI and AC exhibited higher drip losses and centrifugation losses, while RFWI and RFAC decreased drip losses and centrifugation losses. Longer thawing time probably led to more damages to the cell membranes and protein structures of the air-thawed meat, and decreased the interception ability of the muscle proteins to water, thus enhancing the mobility of the immobilized water. After thawing, the water not reabsorbed by the myofibrils was eventually excluded as thawing loss. FM had significantly higher L* values and lower b* values, whereas no significant difference was observed between the frozen and thawed ones. During thawing, the decrease in L* values could be due to the decline in the light reflectance caused by the changes in the microstructure and drip loss of meat, whereas higher b* values might be because of some muscle damages caused by ice crystals thus promoted the oxidation reaction. AC had significantly lower a* values probably be- cause of a longer exposure time of the meat to air, thus leading to more myoglobin oxidations during thawing. RFWI and RFAC had significantly lower sensorial exudate and offodor as well as higher sensorial appearance cumulatively resulting in higher over- all acceptance.

Conclusion: The results of this study clearly demonstrated that RFWI and RFAC effectively maintained the water-holding capacity. On the basis of efficiently shortening thawing time and sufficiently maintaining meat qualities, radio frequency tempering combined with the conventional thawing treatments are suggested to be a novel alternative to the conventionally time-consuming thawing methods with superior qualities, thus can be further potentially applied to the thawing of poultry meat in the industrial applications.

Key words: Chicken, Radio frequency, Sensory, Thawing, Water holding capacity