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Development of a Modified Nitric Oxide Reducing Ability Method to Determine the Metmymoglobin Reducing Ability of Meat

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Objectives

Many methods are used to quantify the metmyoglobin reducing activity (MRA) of meat. The metmyoglobin reductase assay (MR) measures enzyme activity after adding exogenous metmyoglobin (MMb) and reduced nicotinamide adenine dinucleotide (NADH) to sample supernatant. MR is difficult and correlates poorly with development of MMb over storage time as it measures potential MRA. Nitric oxide reducing ability (NORA) is commonly used to estimate the inherent metmyoglobin reducing ability (MRA) of meat. NADH has been shown to reduce MMb enzymatically and non-enzymatically in meat systems, therefore there is value in a method utilizing added NADH that quantifies MRA not only enzymatic activity. A modified NORA (MNORA) method could be used to quantify the potential MRA of meat samples given the addition of NADH. The objective of this study was to determine the effect of added NADH on the NORA values of meat samples stored over 9 d.

Materials and Methods

USDA select *T. brachii* (TB) and *B. femoris* (BF) were sliced to 1.27 cm, placed on plastic trays, covered with O_2 permeable LLDPE film and stored at 5°C under fluorescent lighting (150 to 300 lux). On storage d 0, 3, 6, and 9, four 3 × 3 cm^2 squares were excised from separate trim slices from each muscle. Two squares were evaluated using NORA and 2 squares were evaluated using the modified NORA (MNORA) by treating samples with NADH solution (990 ng/mg meat), holding aerobically for 30 min at 5, and then conducting NORA. NORA and MNORA data were reported as initial metmyoglobin formation (IMF), post reduction metmyoglobin formation (PRMF), and relative metmyoglobin reducing ability (RMRA). Storage day was included to evaluate both methods over time as MMb percentage increased. Data were analyzed with ANOVA ($\alpha = 0.05$) using muscle, method, and storage day as main effects. Tukey least squares means were calculated for significant main effects and interactions and mean separations were determined by PDIFF. Simple Pearson correlation coefficients were determined between RMRA from both methods and MMb % over 9 storage days.

Results

PRMF values for MNORA (16.61, 25.71, 35.48%) were less ($P < 0.0001$) than NORA (24.07, 47.86, 50.88%) on d 3, 6, and 9, respectively. RMRA declined over 9 storage days using both NORA and MNORA, however RMRA values were greater ($P < 0.0001$) for MNORA (40.12, 29.07%) than NORA (13.52, 8.76%) on d 6 and 9 respectively, when MMb % was highest. MMb % correlated more highly with RMRA from NORA ($r = -0.44$, $P < 0.001$) than MNORA ($r = -0.24$, $P = 0.019$). RMRA values determined by MNORA were greater than NORA and IMF and PRMF values were greater for NORA than MNORA on d 6 and 9.

Conclusion

The MRA values from MNORA were greater than values from NORA indicating a higher potential MRA than apparent MRA. Pearson correlation data shows that MNORA is less indicative of color stability than NORA which is also true of MR. MNORA will be a more useful method than NORA or MR to determine potential MRA in future studies aimed at extending shelf life of fresh beef.