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Comparison of Nitrite Sources and Reducing Agents on Reactions with Myoglobin and Cysteine Using a Model Meat Curing System

F. D. Rasmussen*, and G. Sullivan

Animal Science, University of Nebraska– Lincoln, Lincoln, NE, 68588, USA
*Corresponding author. Email: frasmussen21@gmail.com (F. D. Rasmussen)

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Objectives

Meat is complex, so a simplified model curing system was used to observe curing reactions. The purpose of this study was to compare the effect of nitrite sources and reducing compounds on the specific nitrosylation/nitrosation reactions of myoglobin and cysteine.

Materials and Methods

Five model curing systems were evaluated: sodium nitrite (SN), sodium nitrite with sodium chloride (NaCl) to equal the salt in celery juice powder (0.5% in solution; SN-NA), sodium nitrite with NaCl and sodium erythorbate (SN-SE), celery juice powder (CP; VegStable 504, Florida Food Products, Inc.), and celery juice powder with acerola cherry powder (CP-CH; VegStable 515). Solutions were made to compare nitrite sources: synthetic sodium nitrite, and pre-converted celery juice powder with and without reducing agents (2.76 mM of sodium erythorbate, or ascorbic acid from cherry powder) at ingoing nitrite concentrations of 0.072, 0.362, 0.725, 1.087, and 1.450 mM (equivalent to 10, 50, 100, 150, and 200 ppm added to the final solution). Two model meat solutions, cysteine (5.06 mM) or cysteine and myoglobin (5.06 mM, and 0.029mM respectively), were prepared in pH 5.6 buffered phosphate. To simulate the curing process, model meat solutions (5ml) were mixed with the curing solutions (5ml) in 13 mL test tubes, capped, heated (30 min. at 40°C, 30 min. at 80°C) and cooled (15 min. at 23°C). Three replications were made. All samples were analyzed for residual nitrite, sulfhydryl groups, and reducing capacity. Solutions containing myoglobin were evaluated for cured meat pigment. Data were analyzed as a completely randomized design in a factorial arrangement of treatments (5 curing systems, 5 ingoing nitrite concentrations, 2 model meat solutions) for interactions and main effects using GLIMMIX procedure of SAS (SA Inst. Inc., Cary, NC). For significant effects ($P \leq 0.05$), LS means separation was conducted using a Tukey adjustment.

Results

A significant curing system by ingoing nitrite concentration interaction occurred for residual nitrite, and sulfhydryl groups ($P < 0.05$). More residual nitrite was in systems without reducing agents (SN, SN-NA, CP) than SN-SE and CP-CH and increased with higher ingoing nitrite. In all treatments, sulfhydryl groups decreased as ingoing nitrite increased and CP, CP-CH and SN-SE treatments had more sulfhydryl groups than SN and SN-NA. Curing systems with reducing agents (SN-SE, and CP-CH) showed greater ($P < 0.001$) reducing capacity than SN, SN-NA and CP. The reducing capacity decreased with increasing ingoing nitrite in all curing systems ($P < 0.001$). Curing systems with reducing agents had greater ($P < 0.001$) cured meat pigment, and all curing systems had similar cured meat pigment with ingoing nitrite concentrations higher than 50 ppm ($P < 0.001$). The cysteine and myoglobin model had greater sulfhydryl groups and residual nitrite ($P < 0.001$) than the cysteine only model.

Conclusion

Using model meat curing solutions, synthetic and natural curing systems result in similar curing reactions with myoglobin and cysteine. SN and CP had similar concentrations of residual nitrite and cured meat pigment, but CP, CP-CH, and SN-SE treatments had greater sulfhydryl groups. Salt found in CP did not affect curing reactions. Nitrite reactions occur with myoglobin before cysteine. This supports similar cured meat characteristics observed in meat cured with synthetic and natural compounds.

