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Effects of Nitrite Source, Reducing Agents, and Holding Time on Color Development in a Cured Meat Model System

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Objectives

The objective of this study was to determine the effects of nitrite source, the addition of reducing agents, and holding times prior to cooking on color development in a cured meat model system.

Materials and Methods

Emulsified beef sausages were manufactured using 4 different combinations of nitrite sources and reducing agents: 1) sodium nitrite (SN; 156 ppm), 2) SN (156 ppm) and sodium erythorbate (SE; 495 ppm), 3) pre-converted celery juice powder (CJP; VegStable 504, Florida Food Products, Inc., Eustis, FL; providing 100 ppm of sodium nitrite), 4) CJP (providing 100 ppm of nitrite) and cherry powder (CP; VegStable 515, Florida Food Products, Inc., Eustis, FL; providing 440 ppm ascorbic acid). Beef, ice (20%), salt (2%) and the appropriate amount of sodium nitrite and reducing agents were chopped for 1 min in a food processor at 2000 rpm (Blixer 6V, Robot Coupe, Robot Coupe, Ridgeland, MS). For each treatment, the meat batter was placed in 5, 100 mL beakers, and held at 21°C for 5, 15, 30, 60, and 120 min prior to cooking. The emulsions were cooked in a water bath for 30 min at 40°C and 30 min at 80°C and then cooled for 30 min in an ice bath. Samples were then evaluated for objective color (Minolta CR400; L*, a*, b*), residual nitrite, total meat pigment, and cured meat pigment. Three independent replications were produced. Data were analyzed using the GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC) using a 2 × 2 × 5 factorial arrangements with main effects of nitrite source, with or without reducing agents and holding time and their interactions. Means were separated using Tukey's adjustment ($P \leq 0.05$).

Results

A significant nitrite source by reducing agent interaction was identified for cured meat pigment and residual nitrite ($P \leq 0.006$). The SN+SE samples had the greatest amount of cured meat pigment (130.9 ppm) followed by CJP+CH (127.8 ppm), SN (74.7 ppm), and CJP (51.9 ppm) where each treatment was different than all other treatments. Residual nitrite was greatest in SN (79.7 ppm), SN+SE (62.6 ppm) and CJP (59.3 ppm) were intermediate and similar, and CJP+CH (31.64 ppm) had the least. Treatments with reducing compounds (SE or CP) were more red ($P < 0.001$; a* 15.8) and less yellow ($P = 0.016$; b* 8.8) than those without reducing compounds (a*10.7; b* 9.2). Similarly, samples cured with SN were more red ($P < 0.001$; a* 13.9) and less yellow ($P = 0.009$; b* 8.8) than those cured with CJP (a* 12.6; b* 9.2) but the differences were not as great the effect of reducing agents. Total meat pigment ($P > 0.06$) and L* ($P > 0.32$) were not affected by nitrite source or reducing agents. Holding time was not included in any significant interactions ($P > .349$). The only significant main effect of holding time was for a* ($P = 0.011$) where sausages held for 120 min was more red than those held for 5, 15, and 30 min.

Conclusion

The addition of reducing agents (SE or CP) had the largest impact on cured meat color development and reduced the residual nitrite in a cured meat model system. Treatments with SN had slightly greater cured color development than CPJ treatments. Holding times prior to cooking had limited impact on cured meat color development.

