The potential role of nitrite-embedded film in extending the color stability and shelf life of a cured, cooked meat product.

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I. INTRODUCTION

Alternatively-cured meats generally rely on natural sources of nitrates and/or nitrites, which are primarily derived from vegetable sources, but substitution of conventional nitrite/nitrate with natural sources can result in vegetable-like flavors and aromas [1]. Therefore, processors may opt to decrease the relative ingoing level of nitrites and/or nitrates in alternatively-cured meat products to account for potential vegetable-life flavors. This finding has held true with the evaluation of many commercially-produced, alternatively-cured meat products. With regard to residual nitrite concentration, many of the alternatively-cured products available in the marketplace have been found to be, on average, lower in nitrite concentration but also highly variable in the amount of nitrite present [2]. This reduction in nitrite concentration can potentially lead to a decreased color stability and a reduced shelf life. Additionally, consumer perception of natural sources of nitrite has led to consideration of other nitrite alternatives. Some ingredient companies also market natural cure replacers as “no-to-low residual nitrates/nitrites” which can also lead to color instability in alternatively-cured products [3]. In fresh meat, active packaging technology has shown improvement in packaged meat color and shelf life. For example, nitrite-embedded film (NEF) technology have been shown to effectively improve the shelf life and color stability of fresh meat products [4], [5]. NEF is generally recognized as safe (GRAS No. 228) with a low nitrite loading of 113 mg/m^2 NO_2 embedded in the film and the nitrite is considered a processing aid, thus, does not require labeling [6]. However, nitrite-embedded film has not been studied relative to potential impact on cured, cooked meat color. The objective of this study was to determine the efficacy of NEF in extending the color stability and shelf life of alternatively-cured, all-beef bologna, a cured, cooked meat product.

II. MATERIALS AND METHODS

Three different product formulations were manufactured with five treatments of all-beef bologna. The five treatments consisted of a vacuum-packaged, conventionally-cured (sodium nitrite with sodium erythorbate) control (CON), and two alternatively-cured (nitrite from cultured celery juice powder with cherry powder) treatments, with one treatment packaged in vacuum packages (CJP) and the second treatment packaged in NEF pouches (CJP-NEF). An additional two alternatively-cured (Natpre T-10 EML Plus S, supplied by Wenda America, Inc.) treatments were produced with one treatment packaged in vacuum packages (NT10) and the second packaged in NEF pouches (NT10-NEF). After thermal processing and chilling, the bologna logs were sliced to 6.35 mm thick and 4 slices were packaged into either traditional vacuum packages or NEF pouches. All treatments and replications were manufactured and packaged in the Iowa State Meat Laboratory, Ames, IA. All packaged treatments and replications were subsequently stored at 1°C under simulated, continuous retail display conditions using fluorescent lights for the duration of the study. Light source distance was standardized to achieve 2200 lux on the package surface. The illuminance was measured using a portable light meter. Color (CIE L*, a*, b*) of external and internal slices surfaces were measured, as was external and internal residual nitrite and nitrate on days 1, 6, 13, 27, 41, 55, 69, 83, 97, 111, and 125 post-packaging. Microbial analysis was conducted on days 0, 7, 14, 30, 60, 90, and 120 for both aerobic and lactic acid bacteria populations. A microbial detection limit of 5 CFU/g was used. The treatments were replicated twice and statistically analyzed using a mixed procedure with the Statistical Analysis System (SAS, v9.4). The experimental design consisted with of a 2 x 2 + 1 factorial design. A mixed procedure with a Tukey-Kramer pairwise comparison adjustment was used to determine differences over time with significance determined by p-values less than or equal to 0.05.

III. RESULTS AND DISCUSSION

The results for external color a* values (redness) indicate that NT10 was significantly lesser compared to all treatments ($P<0.05$), and NT10-NEF was significantly greater than NT10 ($P<0.05$). Redness and residual nitrite in CJP was equivalent to CON ($P>0.05$). CON a* value did not change significantly during storage ($P>0.05$). External and internal color a* value increased significantly in NT10-NEF over the first 27 days of storage ($P<0.05$). Other treatments did not differ in external and internal a* values ($P>0.05$). External and internal residual nitrite values were significantly lesser in both NT10 and NT10-NEF compared to other treatments ($P<0.05$). Results show increased external and internal redness for low nitrite-containing products (NT10-NEF) packed in NEF without significantly affecting residual nitrite levels ($P>0.05$). Bacterial growth counts indicated no difference between treatments ($P>0.05$).

IV. CONCLUSION

Results show increased external and internal redness for low-nitrite containing products (NT10-NEF) packed in NEF without significantly affecting residual nitrite levels. Therefore, results showcase promise of using NEF technology for increasing the color stability in low nitrite-containing and alternatively-cured meat products. Results suggest a novel cured color development concept through utilizing NEF technology to generate cured color.

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