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Light-Induced Discoloration of Sliced Packaged Salami is Non-Reversible

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Objectives

Sliced fermented salami sausages packaged in modified atmospheres (MA) are prone to discoloration by a combination of residual O_2 in the headspace and light at retail display. To avoid discoloration, packages of uncooked salami should be stored in darkness until all O_2 is removed by internal processes in the product, usually within a few days. The aim of this study was to determine if the color of salami could return from brown to red by extended illuminated display in packages with MA`s, in which residual O_2 was present in the early, but not the later stage of display.

Materials and Methods

Dry fermented raw salami was produced with pork, pork fat, beef, starter culture, salt, sugars and 120 ppm sodium nitrite. Packages with 150 g sliced salami were inserted with air and CO_2 through self-sealing septas to contain approximately 5% O_2, 50% CO_2 and 45% N_2 with a gas to product ratio of 1.1 to 1. The lower and upper films for the packages were laminates with EVOH as O_2 barrier. The transparent packages were exposed to continuous LED light type 68 W 830 (Glamox AS, Oslo, Norway) of 3.5 W/m^2 (1100 lux) for 10 d at 20°C. Concentrations of O_2 in the packages were measured at the time of packaging and d 1, 2, 3, and 4 of display with a Checkmate 3 instrument (Dansensor, Ringsted, Denmark). CIE L*a*b* values (lightness, redness and yellowness) were analyzed through the packaging films at d 0, 1, 2, 3, 4, 7, and 10 of display with a Minolta Chroma Meter CR-400 (Konica Minolta Inc., Tokyo, Japan). The experiment included 3 batches of salami with 5 packages per batch. Analysis of variance was performed for all data using a general linear model in Minitab 17 Statistical Software (Minitab Inc., State College, PA, USA), and means were separated by Tukey's multiple comparison test.

Results

Concentrations of O_2 were reduced from the initial 5% to 0% at d 4 of display. The initial a* values of sausages from the 3 batches were approximately 16, which is fully red. Within 2 d of display, a* values were substantially reduced to 9 to 10 ($P < 0.05$), with a distinct browning or discoloration. By end of display at d 10, a* values were slightly higher at 10 to 11 ($P < 0.05$), but sausages were still clearly discolored. L* and b* values were not affected by residual O_2 and light display ($P > 0.05$). Packages from 1 of the 3 batches had higher O_2 concentrations at d 2 and 3, consistent with slightly lower a* values of the sausages at the middle and late period of display than the other 2 batches ($P < 0.05$).

Conclusion

Illuminated display of salami slices in MA`s with initial high residual O_2 resulted in a non-reversible discoloration of the product, despite that it was kept under anaerobic conditions for the middle and late display. A subsequent and minimal increase in a* value at this time of display would not be noticed by consumers.

