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High Pressure Processing Effects on All Beef Summer Sausage Quality

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Objectives

Summer sausages are currently fermented to a lower pH (≤ 4.6) and mildly heat treated to temperatures of $\geq$ 54.4°C to meet USDA FSIS performance standards for *E. coli* O157:H7. Alternatives such as high pressure processing (HPP) may allow for processing with greater pH and lower temperatures while still meeting performance standards, however, the effect of HPP and different processing parameters on sausage quality is not known. The objective of this project was to evaluate HPP in combination with greater pH and minimal heat treatment for their effects on sausage quality.

Materials and Methods

Three replicates of all-beef summer sausage products (11% fat) were produced following: (i) pH 4.6, 54.4°C with a traditional smoke house and cooler chill (T); (ii) pH 5.0, 54.4°C T; (iii) pH 5.0, 54.4°C with ice bath chilling (RC); (iv) pH 5.0, 48.9°C RC; and (v) pH 5.0, 43.3°C RC. After chilling, sausages were sliced (3.1 mm), vacuum packaged, transported to a commercial HPP processor, and subjected to HPP at 586 MPa for 0, 1, 150, or 300 s. Post HPP sausages were evaluated for proximate analysis ($n = 9$), lipid oxidation ($n = 9$), objective color ($n = 9$), texture profile analysis ($n = 15$; hardness, springiness, cohesiveness, gumminess, and chewiness), and sensory characteristics ($n = 9$) including firmness, cohesion, springiness, and gumminess using trained panelists. Data were analyzed using Proc Mixed (SAS v9.4; SAS Inst. Inc., Cary, NC), as a completely randomized split plot design. The raw sausage chubs were considered the whole plot to which cooking treatments were applied, and the cooked chubs were the split plot, to which HPP times were applied.

Results

The fat content of the sausages was similar ($P = 0.17$) among all treatments. There was no difference for moisture:protein attributed to final pH/cooking endpoint or HPP time ($P > 0.63$), nor was there a difference for lipid oxidation due to pH/cooking endpoint ($P = 0.45$) or HPP ($P = 0.69$). Objective color measurements showed that fermentation of summer sausage to pH 4.6, heated to 54.4°C, and traditionally chilled was lighter in color (greater L*; $P < 0.01$) than all other pH/cooking endpoint combinations which were similar ($P > 0.17$). Additionally, treatment (i) was less red (lower a*; $P < 0.01$) than all other treatments while (iv) and (v) exhibited the greatest redness ($P < 0.01$). Samples became less red and had more fading as HPP time increased ($P < 0.05$), however, the differences were small in magnitude. Texture profile and sensory characteristic analysis were in agreement and showed that as cooking intensity increased so did the hardness of the sausage ($P < 0.01$). Similar trends were noted between sensory characteristics and texture profile analysis, with a positive correlation between cooking intensity and the springiness, cohesiveness, and gumminess of the sausage products. High pressure processing also had an effect on springiness and gumminess ($P < 0.05$), however sensory panelists were unable to detect differences ($P > 0.46$) for these same attributes.

Conclusion

High pressure processing at 586 MPa for up to 300 s can be used as an alternate method for manufacturing beef summer sausages with marginal impacts on final product quality. Further research needs to be conducted to evaluate the efficacy of the process in reducing *E. coli* O157:H7 and other STEC population using this alternate summer sausage manufacturing process.

