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Incorporation of β-Glucans in Meat Emulsions through Modeling Systems

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Objectives

Recent trends suggest novel ingredients can be added to meat products to achieve lower fat while incorporating functional compounds such as soluble fiber into the product. Incorporation of β-glucans (βG) at high quantities into meat products is an opportunity to provide recommended daily soluble fiber intake (3 g/d). This work aimed to evaluate the effects of the incorporation of βG in meat emulsions with modeling systems using carrageenan (C) and starch (S) as supplemental ingredients.

Materials and Methods

Modeling systems were accomplished with the incorporation of βG, C, and S in beef emulsions using an experimental design by "*Design for constrained surfaces and mixtures*". The inclusion level of βG were selected based on daily intake requirements of this fiber (FDA recommendation of 3 g/d). Meat emulsions were manufactured with a standard formulation consisting of 59.2% lean beef, 10% olive oil, 24.4% water, 2% sodium chloride, 0.35% sodium polyphosphate, and 0.01% sodium nitrate. The emulsions were then combined with βG, C, and S according to 14 treatments generated by the software. Subsequently, the emulsions were packaged in collagen casings and vacuum sealed, weighed, and refrigerated at 4 ± 1°C until further analysis was conducted. Cooking loss (%), instrumental color, and textural profile analysis (TPA) were analyzed for the determination of optimal emulsion characteristics. Fitting response value was conducted using linear, quadratic, and cubic models. The results were expressed as the mean of 3 independent replicates and ANOVA was used to evaluate the statistical significance ($P < 0.05$) of each model equation. Then, the best mathematical models to describe cooking loss, instrumental color, and TPA were selected. The content of βG, TPA parameters, color, and microstructure were performed on the optimized emulsion to determine desirability.

Results

The cubic models were best at describing cooking loss, instrumental color, and TPA parameters, with the lone exception of springiness. Emulsions with greater levels of βG and S had less cooking loss (< 1%), intermediate L* values (between 54 and 62 units), and greater hardness, cohesiveness, and springiness values compared with emulsions with lower levels of βG and S. The βG/S interaction showed a synergistic effect for cooking loss, while the use of C was eliminated during the optimization. The optimized emulsion contained 3.13 ± 0.11% βG, which could meet the daily intake levels of βG recommendations. Cooking loss, lightness (L*), and cohesiveness presented values similar or close to those expected by the optimization. On the other hand, hardness of the optimized emulsion was greater than planned and springiness decreased, possibly because the water was immobilized. Finally, the optimized emulsion presented a greater degree of aggregation, more compact and homogeneous structure with smaller pore size indicating the complete incorporation of hydrocolloids in the protein matrix.

Conclusion

Addition of βG and its mixtures with C and S decreased cooking loss and increased lightness (L*). Homogeneous mixtures were created with greater degree of aggregation, without requiring the binding capability of C. The optimization allowed for manufacturing of emulsions with lesser quantities of S and greater quantities of βG while achieving appropriate technological characteristics with the exception of hardness, which was greater in the optimized emulsion.

