Project Summary

Optimize the Quality, Consistency and Shelf-Life of Marinated Fresh Beef Products

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Background

Enhanced (i.e. injected with a marinating solution) pork and chicken products are commonplace in the retail fresh/frozen meat case. Previous studies have shown that a majority of consumers overcook their beef to temperatures that might lead to a less than desirable eating experience. Beef cuts injected with solutions designed to keep the cut tender and juicy even at higher cooked temperatures might lead to more consistently good consumer eating experiences.

Enhanced beef products are becoming more widespread in the retail marketplace. In most cases, beef is pumped with a variety of compounds designed to enhance its texture, flavor, and consistency. The ingredients typically include salt, phosphate, sodium lactate, and seasoning and flavorings that both protect flavor stability (reduce oxidation) and enhance flavor.

Marination technology is one process that could be used to obtain the optimum appearance, flavor, texture and shelf life in beef products. Previous research involving this type of technology has centered on sodium tripolyphosphate, sodium lactate, and sodium chloride. In this research, two products were used in varying pump formulations, buffered sodium citrate (IONAL™) and tetrapotassium pyrophosphate (MYOSAL™), both products of WTI, Inc., Kingston, NY.

The objective of this study was to quantify the effects of injection solution type, dark storage time, and retail display time on moisture retention and color. Differences in moisture retention by muscle type were also examined.

Methodology

USDA Select beef shoulder clods, eye of rounds and inside rounds were obtained from a local meat processor and transported to Kansas State University under refrigeration. Triceps brachii (TB) was removed from the shoulder clods and muscles obtained from the round included Semimembranosus (SM) and Semitendinosus (ST).

The beef muscles were needle injected with one of three formulas at a 10% pump rate as follows:

- Control formulation of distilled water, sodium chloride (2.7%) and sodium tripolyphosphate (3.5%). This was determined to represent current industry formulations.
- Distilled water and buffered sodium citrate (BSC - Ional®) at 0.5% and 1.0%.
- Distilled water and tetrapotassium pyrophosphate (TPPP - Myosal®) at 0.125% and 0.25%.

After injection, muscles were vacuum-tumbled for 10 minutes, rested for 5 minutes, and tumbled for an additional 5 minutes. Tumbling is done to distribute the solution more evenly throughout the muscle.

Whole muscles were then vacuum packaged in nylon/polyester barrier bags and allocated into one of two periods of dark storage (3 or 6 days). After storage, the muscles were cut into steaks and overwrapped with PVC film, followed by five days of retail display. Weight loss of muscles was calculated after 3 or 6 days of dark storage and for steaks at the end of the five-day retail

display period. During each day of the retail display period, an objective measure of color was obtained using a hand-held Hunter colorimeter.

Findings

Weight Loss Whole Muscles after Dark Storage

The addition of BSC or TPPP resulted in less weight loss for the Semimembranosus (SM) and the Semitendinosus (ST) muscles compared to the control group. The Triceps brachii (TB) muscle exhibited much less weight loss compared to the other muscles and the addition of BSC and TPPP did not significantly affect the retention of these solutions compared to the control group. This suggests that the TB has a greater ability to retain moisture compared to the SM and ST.

Weight Loss Steaks after Retail Display

There is a significant storage effect for the SM steak at retail display, with the 3-day dark storage samples losing an average of 1.1% more than the 6-day samples. This could be explained two ways: Either the 6-day storage samples had less retained moisture to lose than the 3-day samples or continued storage of the injected muscles results in a lowered loss in steaks. There were no significant differences in moisture loss for steaks after retail display due to storage time or treatment for both the ST and the TB.

To compare muscles across treatments and storage days, the previous data given on muscle and steak loss show that the TB has the highest ability to hold moisture. The SM shows higher losses than the other two muscles. However, even though the SM had a higher moisture loss for whole muscles after dark storage, the moisture loss of steaks after retail display was lower than the other two muscles.

There were no significant interactions or differences in treatment and storage time relative to color variations. Color deterioration measures were not collected, however comparing the L*(luminescence) values and a* (redness) among variables concludes the color changed equally across treatments and storage days.

Implications

Needle injected or enhanced beef products may be one method that affords the consumer a more consistent eating experience. The findings of this study suggest that there are several general recommendations that can be made. The addition of TPPP had the greatest affect on moisture retention, especially for the SM and ST muscles after dark storage. Steaks at retail display for the SM exhibited a lower moisture loss (i.e. less purge) compared to the other two muscles, suggesting this muscle might appear more desirable to the consumer. The focus of this study was moisture retention; however, research examining the sensory characteristics of beef products injected with BSC and TPPP solutions may also be warranted.

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