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EFFECT OF HYDRODYNAMIC PRESSURE AND THE KOSHERING PROCESS ALONE OR IN COMBINATION ON BEEF STRIP LOINS

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Background:

Koshering meat, an ancient biblical processing method which consists of soaking, salting and rinsing meat has been shown to be effective in reducing generic E. coli and salmonella on beef briskets (Hajmeer et al., 1998). The preservation of meat with salt is based on salt having a drying effect on both the meat and microorganisms. The application of high pressure (hydrostatic) has been shown to inactivate many foodborne pathogens and spoilage organisms. Hydrodynamic pressure technology, a new strategy developed by this laboratory for instantaneously tenderizing meat, may also have the ability to increase the safety of meat by inactivating microorganisms.

Vacuum packaged koshered meat has been criticized for undergoing a rapid color change (turns brown) and an odoriferous odor formation during refrigeration. The salting of meat has been recognized to have tree effects on meat color: (1) acting as a pro-oxidant for heme pigment oxidation, causing meat to turn brown; (2) denaturing enzymes; and, (3) increasing water-binding capacity of meat proteins, thereby rendering the tissues more translucent and darker (Price and Schweigert, 1987).

Objectives:

This research was conducted to determine the effect of hydrodynamic pressure and the koshering process either alone or in combination on the microbial growth, pH, color and odor development during refrigerated storage.

Materials and Methods:

Five beef strip loins were removed from Angus crossbred steer carcasses at 4-d postmortem and cut into four equal sections. Each section was randomly assigned to one of the following treatments: (1) control (C)-non-treated; (2) koshered (K) meat (soaking in water for 30 min, followed by covering with coarse salt for one hour and then rinsing the meat three times with tap water; (3) hydrodymanic pressure (H) treatment (100 g explosive in stainless steel (54 liter capacity) chamber; (4) the combination of koshering followed by hydrodynamic pressure (KH) treatment. Each sample from each treatment was evaluated immediately after completing the hydrodynamic pressure treatment (d 0 values). All samples were vacuum packaged and stored for 14 d at 2 C after which they were evaluated for microbial flora, pH, color stability and odor.

Results:

No differences among treatments were found in muscle pH at either day 0 or day 14 (Table 1). Microbial flora (aerobic plate count = APC) determination at day 0, immediately after treatment applications, revealed a 42% reduction in microbial flora as a result of treatment applications compared to the controls (log 3.63=C; 2.11=K; 2.12=H; 2.12=KH) . Following the 14 day refrigerated storage bacterial numbers increased to a log of 5.0 in the control samples. Koshered meat samples increased to log 3.8 after 14 days of storage. Hydrodynamic pressure treated samples remained unchanged (log 2.4) after 14 days of storage while the KH combination treatment resulted in an increase in APC to log 3.2 compared to controls..

No lean color differences among treatments were found at day 0, however, at 14 d significant differences due to treatments were observed for both instrumentally (Table 1) and visually appraised lean color stability. Lean surface color visually assessed by a panel found the lean color to be slightly bright cherry-red in color at 0 d for all four treatments, however, at 14 d only the C, H, and KH treated samples remained slightly bright cherry-red. The K treated samples were slightly dark cherry red in color (Figure 1). These visual differences were confirmed using instrumental color measurements (Table 1; L*, a*, b* values). No differences among treatments were found for off-odors at either day 0 or day 14.

Conclusions:

These data suggest that hydrodynamic pressure was more effective at inhibiting the normal spoilage microbial flora than koshering or the combination of koshering and hydrodynamic pressure. Microbial numbers increased for C, K and KH treatments (slower rate for K and KH) after 14 d of storage, however, no increase in numbers were observed for the H treatment. Salting (K) meat resulted in a brown/darker color. Hydrodynamic pressure treatment when combined with K treatment eliminated this color problem.

Pertinent Literature:

Hajmeer , M.N., Marsden, J.L., Crozier-Dodson, B.A. & Higgins, J.J. 1998. Microbial reduction due to the koshering process. Presented at annual Food Safety Consortium, Released Newsletter, vol 8, #3.

Price, J.F. and Schweigert, B.S. 1987. The Science of Meat and Meat Products. 3rd Edition. Food Nutrition Press, Inc. Westport, CT.

Table 1. Characteristics of Koshered and Hydrodynamic Pressure Treated Beef Strip Loins

	Control	Koshered[1]	Hydro[2]	Koshered & Hydro[3]
Day 0				
pH	5.6	5.5	5.5	5.4
APC[4]	3.63^{a5y}	2.11^{by}	2.12^{b}	2.12^{by}
Lean Surface Color				
L*-value	36.7	35.3	37.1	34.3
a*-value	16.9	15.8	15.9	15.0
b*-value	7.9	6.0	6.0	5.5
a/b-value	2.1	2.6	2.6	2.7
Day 14				
pH	5.5	5.5	5.5	5.5
APC	5.02^{ax6}	3.76^{bx}	2.40^{c}	3.24^{bx}
Lean Surface Color				
L*-value	39.3^{a}	33.9^{b}	40.1^{a}	34.8^{b}
a*-value	17.4^{a}	13.8^{b}	17.7^{a}	15.5^{b}
b*-value	6.1^{ab}	7.3^{a}	6.2^{ab}	5.2^{b}
a/b-value	2.9^{a}	1.9^{b}	2.9^{a}	3.0^{a}
Lean Interior Color				
L*-value	41.1^{a}	37.8^{b}	41.3^{a}	37.6^{b}
a*-value	19.5	18.7	19.9	18.1
b*-value	9.3	8.5	9.2	7.9
a/b-value	2.1	2.2	2.2	2.3

[1]Koshered = Soaking in water 30 min followed by covering with coarse salt for 1 h and then rinsing meat three times in tap water.
[2]Hydro = Hydrodynamic shock wave treatment (100 g explosive).
[3]Combination of koshering followed by hydrodynamic shock wave.
[4]APC = Aerobic plate count (log).
[5]Means in any row with different superscripts (a,b,c) differ (P<.05).
[6]Means for common characteristics in a column with different superscripts (x,y) differ (P<.05).