

# THE EFFECT OF FREEZING ON AGING OF BEEF

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## Story In Brief

Aging of beef carcasses to improve tenderness has been practiced for many years. This study was designed to determine the effect of freezing on the rate of aging and the tenderization of beef. Wholesale loins from the right and left sides of 5 beef carcasses were cut into 1 inch steaks. Two steaks from each side were assigned to aging periods of 2, 5, 14, or 21 days. Steaks from the right side were aged prior to being frozen while steaks from the left side were frozen and then aged for the prescribed period. Although steaks from the left side indicated a higher loss of moisture during the aging period, there were no differences between the two methods for Warner-Bratzler shear values. This study indicates that the enzymes responsible for aging after 48 h postmortem do not appear to be affected by the freezing process.

(Key Words: Beef, Aging, Freezing.)

## Introduction

A major factor influencing consumer acceptance of meat is the degree of tenderness. It has been found that meat is more tender after a 7 to 10 d postmortem aging period than the day after slaughter (Smith et al., 1978). Although beef is normally fabricated 48 to 72 hr after slaughter, beef wholesale cuts may be shipped to refrigerated warehouses to be frozen and stored for an undetermined period of time.

The reduction in temperature, due to freezing, slows biological processes and extends shelf-life. During this process, moisture in meat forms ice crystals that can damage the cellular structure. The more rapid the freezing process, the smaller the ice crystals resulting in less destruction. The degree to which the cellular structures are damaged can have an effect on the degree of moisture release, including the water-soluble enzymes responsible for tenderization.

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Proteolysis of myofibrillar proteins is a major contributor to meat tenderization during postmortem storage. Calkins (1988) found that calcium-dependent protease I (CDP-I) helps to establish initial meat tenderness and cathepsins B and H are responsible for the tenderization that occurs over longer periods of aging. Koohmarie (1989) found that the activity of the CDP-I and CDP-II proteases were stable, whereas, the CDP inhibitor was unstable after being subjected to freezing temperatures. These studies suggest that a more rapid rate of aging during the initial storage period can be expected in beef that has been frozen. This study was conducted to determine if freezing has an effect on the rate of aging and the tenderization of beef.

## Materials And Methods

Wholesale loins obtained from the right and left sides of 5 beef carcasses were weighed and cut into 1" steaks. Two steaks from each side were assigned to an aging treatment of 2, 5, 14, or 21 d totalling 40 steaks examined for each aging period. Each steak was weighed and vacuum packaged.

All steaks from the left side of each carcass were immediately frozen (-20°C), allowed to thaw for 18 h, and aged for the assigned period. Steaks from the right side were placed under refrigeration (40°F) for the assigned aging period and then frozen. Opposite sides were used in the treatments to remove any animal effect. Aging periods were scheduled so that cooking of all steaks could be accomplished on a predetermined day, ie: steaks assigned to the 21 d aging period were removed from the freezer 21 d prior to cooking. Eighteen hr prior to cooking, frozen steaks from the right side were removed from the freezer to thaw. Individual weights of the steaks were obtained to determine purge loss and cook loss.

Steaks were cooked at 350 F for 13 min to an internal temperature of 158°F. Six 1/2 in cores were removed parallel to the muscle fibers after the steaks were cooled for two hours at room temperature (68°F). Each core was sheared using a Warner-Bratzler shearing device attached to an Instron Universal Testing Machine. The Instron was fitted with a 10 kN load cell with a crosshead speed of 50 mm/min. Peak force was analyzed as an indication of tenderness.

Analysis of variance tables were obtained using the General Linear Models procedure of the Statistical Analysis System (SAS, 1986). Contrasts were designed to determine differences between aging periods and methods of aging. Appropriate interactions were included in the model.



## Results And Discussion

Purge loss, as defined for this study, was the combination of purge during the aging period and that resulting from the thawing process. Purge loss is therefore an indication of the ability of the meat to retain moisture. Figure 1 shows the regression of thaw loss on aging period. Steaks that were frozen prior to aging showed a linear increase ( $P < 0.01$ ) in the amount of moisture lost during the aging period. In contrast, the data of those steaks aged prior to being frozen indicated no change in moisture loss over the aging period. The aging process may have caused a change in the protein structure resulting in a greater ability for the meat to retain moisture.

Cook loss (Table 1) was not different ( $P > 0.05$ ) between freezing and aging treatments. Figure 2 shows the means of the shear values based on the mean of six cores per steak. Two steaks per side per treatment per animal gave a total of 12 cores at each time period evaluated. No significant difference was observed for cook loss between steaks that were frozen prior to aging and steaks aged prior to freezing.

Enzymes having activity during the aging process have been identified as either short-term or long-term. Calcium dependent proteases (CDP-I)

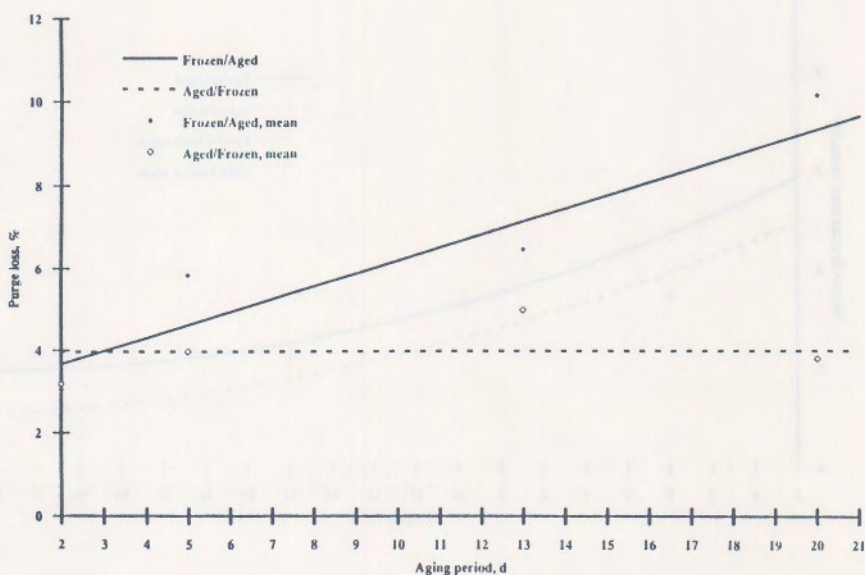


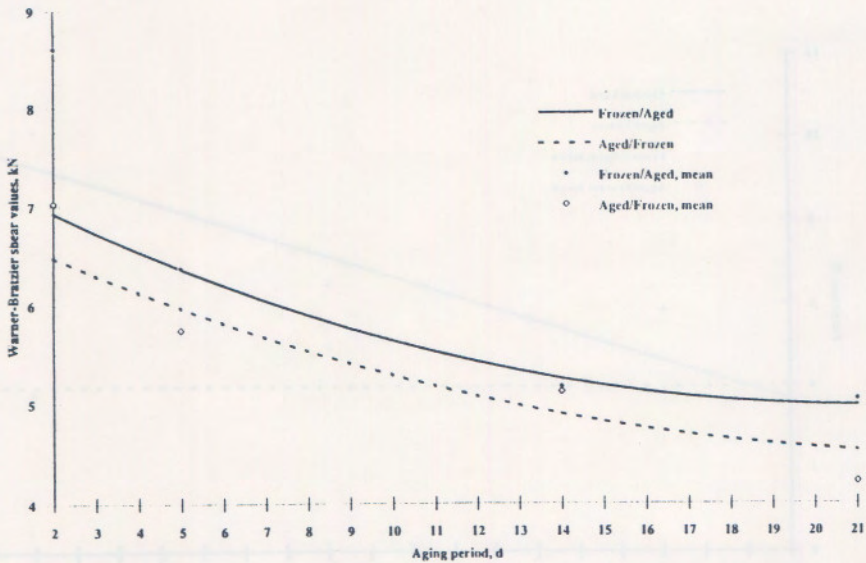
Figure 1. Regression lines showing purge loss as affected by storage method and aging period.

**Table 1. Effect of aging period and storage method on cook loss of beef steaks.**

Aging period, d	Storage <sup>a</sup>	Cook loss, %
2	F/A	27.8
	A/F	27.6
5	F/A	27.0
	A/F	27.0
14	F/A	28.2
	A/F	27.9
21	F/A	28.4
	A/F	28.1
SE <sup>b</sup>		.8

<sup>a</sup> Steaks were either frozen and then aged (F/A) or aged and then frozen (A/F).

<sup>b</sup> SE = standard error.



**Figure 2. Regression lines showing Warner-Bratzler shear values as effected by storage method and aging period.**



establish initial tenderness up to day 2 (Calkins, 1988). After fabrication and vacuum packaging of the right side, cathepsins B and H become the active enzymes that increase tenderization over a long time period (Koochmarie, 1989). These data, however, showed no difference between the two methods of storage. Since aging times began after 48 h, the CDP's should have established initial differences. Having seen no significant differences, it can be suggested that the aging process is not affected by freezer storage if frozen after 48 h postmortem.

This study suggests that freezing of steaks prior to aging causes a linear increase in purge loss, no significant effect on cookloss, and no significant effect on the rate of tenderization as indicated by Warner-Bratzler shear when steaks are frozen after 48 h postmortem.

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