DEXTROSE LEVEL AND HOLDING TIME AFFECTS ON WARMED-OVER FLAVOR OF BEEF TOP ROUND ROASTS

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Story In Brief

Warmed-over flavor (WOF) is known as the off flavor produced from the rapid onset of rancidity in cooked meats. The onset of WOF is immediate, yet can be curtailed by antioxidants, both chemical and natural. One such naturally occurring process with antioxidant effects is the Maillard reaction. The Maillard reaction involves a reducing sugar and amino acid. Dextrose is a reducing sugar with a high consumer recognition and therefore, would not be viewed as a chemical additive. This study was designed to examine the effects of different dextrose levels and holding times on the inhibition of WOF. Top round roasts were injected to 110% initial weight with treatment brines containing 0.2% salt, 0.3% phosphate and one of three different dextrose levels (0%, 1%, 2%). The roasts were cooked at 250° F to an internal temperature of 130° F and then held in a 140° F holding oven for 2 or 6 hours, to mimic institutional handling. 2-Thiobarbituric acid (TBA) analysis showed a significant decrease in WOF with the addition of dextrose and with the 6 hour holding time. The Warner-Bratzler shear force increased significantly with increasing holding times. The results of this study show that the use of dextrose in top round roasts significantly decreases WOF. The use of dextrose could help to produce a convenient precooked beef product without undesirable off-flavors for both institutional and retail use.

(Key Words: Beef, Warmed-over flavor, Dextrose, Maillard reaction.)

Introduction

Convenience has become an important factor in many meal planning decisions. Quickly prepared "heat and serve" products are in demand. To stay competitive, the meat industry must continue to investigate methods to improve convenience. Precooking of beef roasts is a logical method, but has not been widely accepted by consumers, primarily due to off-flavors that

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develop during storage. Precooking would also benefit restaurant and food service operations by reducing preparation time and increasing product utilization. The off-flavors that develop are characterized by a rancid, stale, or metallic flavor produced during lipid oxidation. Tims and Watts (1958) first recognized these off-flavors as warmed-over flavor (WOF). WOF can be effectively detected and monitored through the use of the 2-Thiobarbituric acid test (TBA).

Antioxidants are very effective inhibitors of WOF. Compounds such as nitrite, butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are common additives to meat and poultry products for the inhibition of lipid oxidation. These compounds, however, have a negative connotation among consumers, and enhancing the production of natural antioxidants may be beneficial. With legislation like California's Proposition 65, chemical additives like BHA are being removed from food products and replaced with alternatives that are less controversial (Burditt, 1990).

One such possible alternative could come from the Maillard reaction. During heat processing the Maillard reaction forms products which have been shown to have antioxidant properties. The formation of Maillard reaction products (MRP) is a result of an interaction between proteins and reducing sugars. The formation of MRP is enhanced with the application of heat and with a decrease in moisture, conditions commonly found in food preparation. Dextrose is a reducing sugar and a common ingredient in processed meat products, which gives it high consumer recognition.

This study was designed to determine the effect of dextrose level on the development of WOF and determine the influence of extended holding time on WOF development.

Materials And Methods

Raw material and Product Preparation

Six top round roasts (semimembranosus) were cooked per replication , consisting of two roasts per treatment. The roasts were removed from 4 months of frozen (-20° C) storage and allowed to thaw in a cooler at 40° F for 48 hours, removed form the vacuum packaging and trimmed of all external fat covering. The trimmed roasts were pumped to 110% of initial weight with one of three brine treatments of 0%, 1% or 2% dextrose by a multi-needle hand injector. Brines were formulated with deionized water to achieve a final product concentration of 0.2% salt, 0.3% phosphate and either 0%, 1% or 2% dextrose. The roasts were stored overnight in a cooler (40° F), then subjected to one hour of tumbling under 90% vacuum using a cycle of 20 min on, 10 min off. The roasts were returned to the cooler for 8-10 until cooking.

Cooking and Sample Preparation

The roasts were weighed and cooked 3 per tray, on two stainless steel trays in a Jero Thermaflo cook and hold oven at 250° F. Cooper constantan thermal couples were placed in the geometric center of each roast and temperature was recorded using a Omega OM-5000 data logger. When the internal temperature of 130° F was reached, the roasts were reweighed and placed in a preheated holding oven set at 140° F. After 2 hours of holding the roasts were weighed again, cut in half with the posterior end being placed back in the holding oven for an additional 4 hours to achieve the 6 hour holding time. Holding time treatments were chosen to mimic institutional cook and hold cooking practices.

The roasts were allowed to cool and then individual samples for further analysis were taken from the cut edge of each roast. A 0.75 inch slice was used for Warner-Bratzler shear determination (WBS) and five 0.25 inch slices were taken for the 2-Thiobarbituric acid (TBA) analysis. The slices were overwrapped with white butcher paper and stored in the cooler (40° F) for 8-10 hours. One set of slices from each roast taken for TBA analysis for day 0, the remaining slices were placed individually in Styrofoam trays, overwrapped with polyvinylcholoride (PVC) film, and placed on a rack in the cooler (40° F) to be sampled daily for a one week period. The WBS slices were vacuum packaged and placed in the cooler (40° F) prior to analysis.

Thiobarbituric Acid Analysis

The 2-Thiobarbituric acid analysis was performed to monitor thiobarbituric acid reactive substances (TBARS) in the sample as a result of lipid oxidation. Tarladgis et al. (1960) steam distillation method was used modified with the addition of EDTA and Propyl Galate at the grinding stage as suggested by Rhee (1978), and with the use of filter paper (Whatman no. 4) to purify the distillate. Duplicate samples were taken from each slice of the roasts. A spectrophotometer measured the absorbance of the TBARS at 538 nm.

Warner-Bratzler Analysis

Eight to ten 0.5 inch diameter cores were taken from each of the 0.75 inch thick slices. Warner-Bratzler shear analysis was conducted by attachment to the Instron Universal Testing Machine model # 4502. The peak shear force (N) was analyzed as an objective measurement of tenderness.

Proximate Analysis

Percentage moisture was determined by drying oven method, fat was determined according to the modified soxhlet extraction procedures, and

protein was determined by Kjeldahl digestion procedures according to AOAC (1984). A slice from each roast with each holding time was used and samples were analyzed in duplicate. Product yields and holding yields were determined as a percentage by dividing the end weights by the beginning weights for each phase.

Statistical Analysis

Data were analyzed as a split block with dextrose level (0%, 1% and 2%) as main block and holding time (2 and 6 hour) as split block, replicated 3 times (Steel and Torrie 1980). Means were analyzed by using the Fisher protected LSD (Statistical Analysis System (SAS) 1988). All significant levels were $P<0.05$.

Results And Discussion

Figure 1 shows the results of the dextrose treatments on the TBA values over the 5 day storage period. The roasts with added dextrose showed a significant reduction in the progression of WOF. All treatments follow the same general pattern, however, the 1% and 2% levels significantly impeded the progress of WOF over that of the control, with the 2% dextrose level having a slight advantage over the 1%. This is beneficial to the food service branch of the industry trying to prolong the flavor quality of their products. Further study

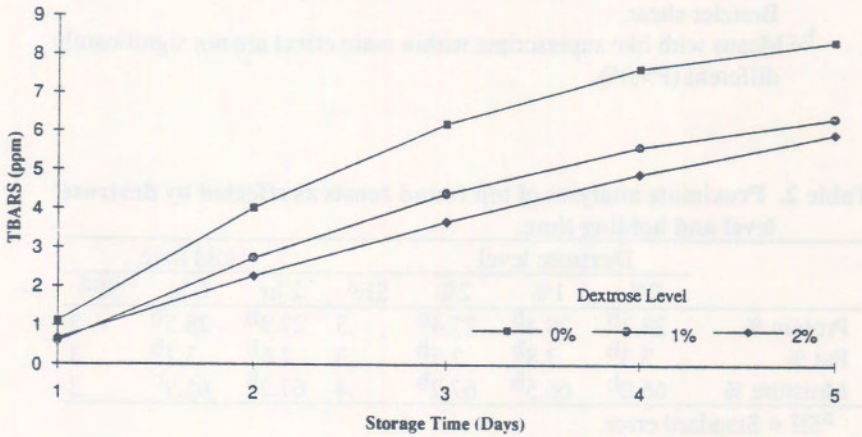

Figure 1. Thiobarbituric acid reactive substances as effected by dextrose level over storage time.

could be conducted to examine if there is a significant inhibition beyond that of the 1% or 2% level and if the addition of higher levels would be practicial for production.

A significant difference between TBA values for the different holding times was observed (Table 1). A lower TBA value was associated with the 6 hr holding period when compared to the 2 hr holding time. This could be due to the increased time in the oven producing a greater amount of antioxidant compounds and/or due to the extra loss of moisture causing a concentration of the antioxidant compounds.

There was a trend for increasing dextrose levels to show increasing moisture content and deceasing fat levels (Table 2). The only significant difference, however, was observed between the 2 and 6 hour holding times, with the 6 hour holding time showing significantly lower moisture compared to that of the 2 hour. While this was not unexpected due to the extra time in the oven, it will decrease the yield and tenderness of the product. So there is a trade off, with increased holding time comes a positive of increased WOF inhibition but also the detrimental effects of loss in yield and tenderness.

Table 1. Holding time effects on thiobarbituric acid analysis and Warner-Bratzler shear peak force.

	Hold time		
	2 HR	6 HR	SE[a]
TBA	4.48[b]	4.02[c]	.11
WBS	25.77[c]	33.17[b]	1.11

[a]SE = Standard error; TBA = Thiobarbituric acid; WBS = Warner-Bratzler shear.

[b,c]Means with like superscripts within main effect are not significantly different (P>.05).

Table 2. Proximate analyses of top round roasts as effected by dextrose level and holding time.

	Dextrose level				Hold time		
	0%	1%	2%	SE[a]	2 hr	6 hr	SE[a]
Protein %	28.7[b]	28.4[b]	27.4[c]	.3	27.9[b]	28.5[b]	.2
Fat %	3.3[b]	2.8[b]	2.5[b]	.3	2.6[b]	3.1[b]	.3
Moisture %	66.0[b]	66.5[b]	67.2[b]	.4	67.2[b]	65.9[c]	.3

[a]SE = Standard error.

[b,c]Means with like superscripts within main effect are not significantly different (P>.05).

There was no significant difference in WBS peak force for the differing dextrose treatments, therefore, there is no decease in tenderness caused by the addition of dextrose. There was also no significant difference in product yields due to dextrose treatment, though the increasing dextrose levels tended to show an increase in yields while the increasing holding times tended to cause a decrease in yields.

Implications

This study suggests that dextrose can be used as an ingredient in beef roasts as an effective inhibitor of warmed-over flavor. The use of dextrose to increase Maillard reaction products as an antioxidant is possible. This may increase acceptance for more convenient, precooked beef roasts.

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