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HOT-BONING AND ELEVATED TEMPERATURE CONDITIONING INFLUENCE ON LAMB COOKING PROPERTIES, PALATABILITY AND CONSUMER ACCEPTANCE

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INTRODUCTION

Considerable interest has developed in technology to improve processing efficiency. Boning of unchilled carcasses (HB) has been demonstrated to be feasible and to improve processing efficiency, functional properties, flavour, juiciness, and cooking losses but to reduce tenderness. Use of elevated temperature conditioning (ETC) prior to chilling should be expected to reduce much of this deterioration in tenderness and produce a more standardized product and to exert its greatest influence on carcasses and cuts with very little fat cover. The present study was undertaken to examine the effects of HB alone and in combination with ETC on the cooking properties, palatability and consumer acceptance of lamb cuts.

MATERIALS AND METHODS

Three hundred and thirty five lambs of three genders (rams, ewes and wethers) and 12 to 15 months of age with slaughter weights between 59 and 77kg were allocated randomly, within gender and weight class, as equally as possible to treatments. The conventional (C) treatment consisted of chilling carcasses immediately after slaughter for 48 hours at 1°C±2°C in a meat cooler with 90% relative humidity and an air velocity of 0.5 meters per second. Carcasses assigned to all other treatments were HB, fabricated into boneless retail cuts, and vacuum packaged. The vacuum packaged cuts were then conditioned at 32°C in low temperature incubators for 0, 2, 4 or 6 hours prior to being transferred to the previously described meat cooler for the remainder of the 48 hour period.

Wholesale loins were weighed, vacuum packaged, frozen at -30°C, and held at this temperature until evaluated (90 to 180 days). All loins were thawed at 4°C for 48 hours and then reweighed to determine thaw-drip losses. A saber thermocouple was inserted into the centre of each loin and they were roasted in an electric convection oven, preheated to 177°C, to an internal temperature of 75°C. Each loin was then reweighed to determine total cooking losses and cooking times were recorded. The drip from each loin was weighed to determine cooking-drip losses, and evaporative cooking losses were obtained by difference. Degree of doneness was subjectively evaluated (1=rare; 5=well done). Loins were then subsampled as previously described (Jeremiah *et al.*, 1983). Subsamples were held in covered glass containers in a circulating water bath (70°C) until evaluated (10 to 15 minutes). Panellists evaluated subsamples using 8-point descriptive scales for initial and overall tenderness (1=extremely tough; 8=extremely tender), amount of perceptible connective tissue (1=abundant; 8=none), juiciness (1=extremely dry; 8=extremely juicy) and lamb flavour intensity (1 = extremely bland; 8 = extremely intense); and the presence of any off flavour or odour was noted. Three cores (13mm) were also removed from each loin using a mechanical cork borer, after the loins had been refrigerated overnight at 4°C. Each core was sheared three times using the Ottawa Texture Measuring System fitted with a Warner-Bratzler blade. Mean shear force value was calculated and recorded.

The shoulders from the right sides were boned, rolled, tied, vacuum packaged, frozen at -30°C and stored at this temperature until subsampled for analysis. Two shoulder roasts were randomly selected from each gender/slaughter

weight/treatment subgroup, resulting in 24 roasts being analyzed per treatment. Shoulder roasts were cooked, subsampled and evaluated as previously described (Jeremiah, 1988). Complete flavour and texture profiles were obtained using a highly trained flavour-texture profile panel as previously described (Jeremiah, 1988).

All panel sessions were conducted in well ventilated, temperature controlled, partitioned booths under 1076 lux of incandescent and fluorescent white light. Room temperature distilled water and unsalted soda crackers were provided to remove flavour residues between sample evaluations.

Legs were boned, rolled, tied, cut into two equal portions, frozen at -30°C and distributed to 500 lamb consuming households for evaluation. Consumers were instructed to prepare the roasts they received using the methods they normally used for lamb leg roasts but to record cooking methods and times and the degree of doneness at the point of consumption. Following preparation each household was asked to reach a consensus rating for the acceptability of the flavour, juiciness, tenderness and overall palatability using a 5-point hedonic scale (1=dislike extremely; 5=like extremely).

Due to lack of meaningful interactive effects of gender and slaughter weight with treatment ($P>0.05$), most data were pooled over weights and genders, using the GLM procedure of SAS (SAS, 1985) to evaluate treatment effects. Non-parametric data from the flavour and texture panels were analyzed using the Chi-Square test (Puri and Mullen, 1980).

RESULTS AND DISCUSSION

HB roasts ETC for six hours were rated more tender than C roasts, unconditioned HB roasts (UHB) and HB roasts ETC for only two hours ($P<0.05$; Table 1). They were also rated the most tender overall and UHB roasts were rated the least tender overall ($P<0.05$). HB roasts ETC for six hours also were perceived to have the least amount of connective tissue and UHB roasts were perceived to have the most ($P<0.05$). UHB roasts had the highest shear force values and HB roasts ETC for six hours had the lowest ($P<0.05$). Therefore, present results confirmed the detrimental effects of HB on tenderness, but ETC for six hours appeared to offset these detrimental effects.

C roasts sustained the lowest total cooking losses and sustained lower evaporative cooking losses than UHB roasts and HB roasts ETC for only two hours ($P<0.05$; Table 1). HB roasts ETC for four and six hours required longer cooking times ($P<0.05$) than C roasts.

Significant positive trends ($P<0.01$) with increasing ETC time were detected for both initial and overall tenderness. A significant positive trend ($P<0.05$) was also observed with amount of perceptible connective tissue indicating connective tissue became less perceptible as ETC was extended. A significant positive trend was also detected in cooking time with increasing duration of ETC, and a significant negative trend was observed in evaporative cooking losses with increasing duration of ETC ($P<0.05$) indicating ETC increased the amount of time required for cooking but reduced evaporative losses during cooking.

HB samples ETC for two hours had less surface moisture than samples from other treatment groups ($P<0.05$); and HB samples ETC for four and six hours had more surface fat than C samples and HB samples ETC for two hours ($P<0.05$). HB samples ETC for six hours were more elastic upon partial compression than samples from other treatment groups ($P<0.05$); and HB samples ETC for two hours and C samples released less fat on the first bite than samples from other treatment groups ($P<0.05$). In addition, C samples were less chewy during mastication than UHB samples and HB samples ETC for two and six hours ($P<0.05$); and HB samples ETC for two and six hours broke down at a slower rate during mastication than C samples ($P<0.05$). Moreover, HB samples ETC for two hours absorbed more moisture during mastication than C samples and HB samples ETC for four hours and UHB samples ($P<0.05$); and HB samples ETC for six hours absorbed more moisture during mastication than HB samples ETC for four hours ($P<0.05$). HB samples ETC for six hours released more fat during mastication than C samples, HB samples ETC for two hours and UHB samples ($P<0.05$); and HB samples ETC for four and six hours left more residual fat than C samples, UHB samples and HB samples ETC for two hours ($P<0.05$). A higher proportion of HB samples ETC for six hours produced an inappropriate residual particle type described as fibrous, grainy, mealy, mushy and gristle than UHB samples ($P<0.05$); and a higher proportion of C samples and HB samples ETC for two hours left an inappropriate residual particle type described as fibrous, grainy, mealy and gristle than HB samples ETC for four and six hours ($P<0.05$). In addition, a lower proportion of HB samples ETC for two hours left an inappropriate residual particle type described as fibrous, grainy, mealy, mushy and stringy than UHB samples and HB samples ETC for four hours ($P<0.05$). Significant trends with increasing ETC time were not detected ($P>0.05$) in any surface, partial compression, or first bite property. However, significant positive trends were observed during mastication for fat and moisture release ($P<0.01$) and a significant negative trend was detected in the proportion of samples with fibres described as being medium minus ($P<0.05$). Significant positive trends with increasing ETC duration were also observed for the amount of residual fat and mouthcoating ($P<0.01$) and the proportion of samples producing inappropriate, residual particle types described as being fibrous, grainy, stringy and gristle ($P<0.05$); fibrous, mealy, mushy, stringy and gristle ($P<0.05$); and fibrous, grainy, mealy, mushy, stringy, crumbly and gristle ($P<0.01$). However, texture amplitude or the appropriateness, balance and blendedness of individual texture character notes did not differ among treatments ($P>0.05$) and a significant time trend in texture amplitude with increasing ETC duration was not observed ($P>0.05$).

The incidence and order of appearance of flavour character notes also did not differ due to treatment ($P>0.05$); and the only difference observed in the intensity of flavour character notes was for the appropriate, fatty/tallowy aromatic, where HB samples ETC for six hours were more intense in this character note than samples in any other treatment group ($P<0.05$). Significant negative trends with increasing ETC duration were observed for the proportion of samples displaying an inappropriate chemical/sour aromatic ($P<0.05$) and the intensities of the appropriate rancid/fatty aromatic ($P<0.01$), the appropriate sweet taste ($P<0.01$) and the appropriate lamby aftertaste ($P<0.05$). However, a significant

positive trend with increasing ETC duration was detected for the speed with which the inappropriate chemical/sour aromatic was perceived ($P<0.05$). A difference in flavour amplitude, or the appropriateness, balance and blendedness of individual flavour character notes, was not observed among treatment groups and a significant trend in flavour amplitude with increasing duration of ETC was not detected ($P>0.05$).

The only treatment effect for consumer acceptance data which approached significance was for the tenderness of butt roasts (Table 2). In this instance, HB roasts ETC for two hours were slightly but not significantly ($P>0.05$) more acceptable in tenderness than those from C carcasses. More than 13 and 16%, respectively, of the UHB, butt and shank roasts were rated unacceptable in flavour (Table 2) and 16% of the HB shank roasts ETC for four hours were rated unacceptable in juiciness. In addition, more than 16, 13, and 11% respectively of the butt roasts from the C, UHB, and HB, ETC (four hours) treatments were rated unacceptable in tenderness. Moreover, 12.5 and 16% respectively of the shank roasts from the UHB, and HB, ETC (four hours) treatments were rated unacceptable in overall palatability and over 13% of the butt roasts from UHB carcasses were rated unacceptable in overall palatability.

CONCLUSIONS

Present results confirm the detrimental effects of hot-processing on tenderness but indicate conditioning of boneless, vacuum packaged cuts for six hours at 32°C is effective in at least partially offsetting these detrimental effects, without significantly influencing other cooking or palatability attributes. It should be noted, however, neither HB alone or in combination with ETC produced meaningful effects on consumer acceptance based upon palatability traits.

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