Eating Quality of Bull and Steer Beef Assessed by Sensory and Objective Methods.

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There have been different conclusions about the eating quality of beef from bulls and from steers. Reagan et al (1971) reported that ratings for tenderness, flavour and overall satisfaction were lower for steaks from bulls than from steers; and Bryce-Jones et al (1964) too had earlier reported that under optimal conditions bull beef tended to be less tender, less juicy and contain less fat than steer beef. However, Hedrick et al (1969) found no significant differences in texture and juiciness rating between steaks from bulls and steers.

Such discrepancies might arise because of differences in cooking methods. In the majority of investigations roasting or broiling has been used. Bryce-Jones (1969) cooked by heating in a water-bath whereas Hedrick et al (1969) used a broiling method. Hence, in this further study of the relative eating quality of bull and steer beef, three different cooking procedures have been compared.

Experimental

Animals : Sixteen Hereford-Friesian animals (8 bulls and 8 steers) were selected from a group of 56 animals on trial at the Hurley Grassland Research Institute. The animals were slaughtered at 15 months of age with an average liveweight of about 960 lb. A five rib section (6th to 11th) was removed from each side and transported to the Meat Research Institute where it was wrapped in polythene and held at + 1°C for seven days.

Cooking Treatments : Samples were cooked by either roasting, grilling or by a water-bath treatment.

Roasting Procedure :- The right side rib sections were boned, rolled and samples removed for water-bath treatment. The remaining portions were roasted to an internal temperature of 74°C in a 175°C oven.

The roast joints were sliced and served to a sensory panel.

Grilling Procedure :- The l.dorsi from left side joints was sliced into 2.5 cm steaks which were grilled under an electric grill for eight minutes per side. One grilled steak per animal was sent for objective analysis, the remaining steaks were sliced into cubes and immediately served to the sensory panel.

Water-bath Treatment :- A 7 cm thick slice of the l.dorsi from the right side rib section of each animal was cut to give a 200 gm portion which was vacuum packed in a plastic pouch, and heated in a constant temperature water-bath at 80°C for 60 minutes. After cooling to room temperature under cold water the meat was removed from the pouch and excess liquid blotted off before weighing. The water-bath treated samples were used for objective analyses.

Sensory Analysis :- A twelve member panel selected from scientific and ancillary staff of the Meat Research Institute was used to evaluate flavour, juiciness, texture, and overall acceptability. Texture was scored on an eight point scale from extremely tender to extremely tough. Flavour and overall acceptability were scored on five point scales ranging from extremely good to not acceptable. Juiciness was scored on a five point scale from extremely juicy to dry. Results were recorded by assigning values to each point of the scales. Highest positive values were assigned to the most desirable qualities.

Objective Tests:- Grilled and water-bath treated samples were sectioned to give pieces 1.0 x 1.0 x 2 cm. The muscle fibre direction was parallel to the 2 cm edge. Ten pieces were sheared as described by Rhodes et al.(1971) with Volodkevitch style jaws in an Instron testing instrument. The results from each shear were analysed by computer to give numerical values for work done during shear, force at first break, final compressive force, maximum positive slope of the force deformation curve, and curve base length.

Sarcomere lengths were determined adjacent to shearing location on each subsample using the laser-diffraction method of Voyle (1971).

Results

Sensory Assessments:- Grilled and roasted samples were assessed for texture, flavour, juiciness and overall acceptability by the sensory panel. The group means and standard deviations for sensory assessments are given in Table 1.

Table 1. Group means for sensory characteristics (standard deviations in parenthe

	Roasted		Grilled	
	Bull	Steer	Bull	Steer
Texture	1.25(1.95)	1.23(2.49)	-0.83(2.04)	1.70(2.44)
Juiciness	1.34(0.46)	1.26(0.50)	1.89(0.26)	1.98(0.38)
Flavour	1.86(0.26)	1.94(0.41)	1.87(0.28)	2.04(0.20)
Overall acceptability	1.76(0.23)	1.90(0.45)	1.64(0.34)	2.10(0.43)

The sensory scores for texture, juiciness flavour and overall acceptability were analysed to determine differences due to sex and cooking method. The F-ratios from analysis of variance of the sensory scores are presented in Table 2.

Table 2. F-ratios for sensory scores of texture, flavour, juiciness and overall acceptability.

	Sex	Cooking Method	Interaction
Texture	3.04	1.06	1.95
Flavour	1.37	0.27	0.18
Juiciness	0.01	19.79***	0.33
Overall acceptability	4.61**	0.08	1.38

** significant P<.05
*** significant P<.01

Overall acceptability showed significant differences between bull and steer samples and a highly significant difference due to cooking method was found in juiciness scores. There was no significant sex x cooking method interactions. The slightly greater overall acceptability ratings for samples

from steers may be a result of slight differences in texture and flavour. Neither of the individual characteristics were significantly different between bull and steer groupings but combined must contribute to the overall acceptability result.

Juiciness scores exhibit no differences between sexes but a highly significant difference exists between beef which was roasted and that which was grilled. The grilled beef was considered the more juicy. This may be a direct result of difference in degree of doneness between roasted and grilled meat.

The large degree of variability between animals within groups and the resultant large variation in scores for texture, flavour, juiciness and overall acceptability would obscure small differences due to sex or cooking method.

Objective Results:- Grilled and water-bath treated samples were subjected to shear measurement and sarcomere length measurement. The means of the six objective measures of texture are presented in Table 3.

Table 3. Means of objective measurements on water-bath treated and grilled l.dorsi muscle samples.

	Water-bath		Grilled	
	Bull	Steer	Bull	Steer
Base length (cm)	0.9295	0.9691	0.8881	0.9013
Total work (joules)	0.2480	0.1673	0.2104	0.1604
Force at 1st break (kg)	5.85	3.38	5.47	4.32
Final compressive force	5.84	4.12	5.40	5.24
Max. slope	23.81	10.08	25.64	18.66
Sarcomere length (μ)	1.53	1.50	1.59	1.39

Analyses of variance applied to the objective data indicated a highly significant interaction between cooking method and sex for sarcomere length. The interaction term was not significant for other characteristics and therefore residual and interaction mean squares have been pooled to test sex and cooking method effects. Sex and cooking method effects for sarcomere length measurements have been tested using interaction mean square as the denominator of the F-ratio. The F-ratios and their significance are presented in Table 4.

Table 4. F-ratios[+] for Objective Characteristics

	Sex effect	Cooking effect	Interaction
Total work	10.68***	1.101	0.476
First max. force	4.73**	0.107	0.592
Final compressive force	2.16	0.299	1.438
Slope	2.86*	0.735	0.152
Sarcomere length	1.612	0.070	13.66***

+ Mean squares tested against pooled interaction and residual mean square except where interaction term significant. Sex and cooking effects on sarcomere length have been tested against interaction term.

*P<.10
**P<.05
***P<.01

Significantly more work was required to shear samples of beef from bulls than those from steers. This difference is much more significant than the difference detected by sensory assessments, possibly due to the lower degree of variation within groups for the objective measure. There was no significant cooking method effect on total work done although grilled samples were always judged slightly more tender than corresponding roasted samples.

Force at first maximum was significantly greater for bull beef than for steer beef (5.66 kg for bull beef compared with 3.85 kg for steer beef). The average first maximum force values for water-bath treated and grilled samples were 4.61 and 4.89 kg respectively but the difference is not significant. Force at end of compression showed no significant differences between sexes or between cooking methods.

Sarcomere length, which previously has been used as an indicator of texture, showed a highly significant interaction between sex and cooking method. This interaction reflects the differences in mean sarcomere length for the different sex-cooking method groups (Table 3). Bull samples posses shorter sarcomere length after water-bath treatment than after grilling whereas steer beef samples exhibited the reverse pattern. The correlation between sarcomere length and total work done during shear was -0.08 for water-bath treatment samples and 0.35 for grilled samples. Both these correlations are non-significant. There was however, a larger correlation betweed grilled sarcomere length results and panel scores for texture (γ= -0.58). Correlation between total work done and panel scores for texture indicated that variation in work done during shear was able to account for 55 percent of variation in panel scores for texture. It is very apparent that sarcomere length is not a good indicator of mechanical properties or of sensory ratings; mechanical properties provide a better index of sensory texture scores.

The overall conclusion of the study is that beef from bulls and steers differs in overall acceptability but that variation within bull and steer groups is often greater than variation between groups. Texture, flavour, and juiciness scores were not found to differ between bulls and steers. Objective methods detected differences between bull and steer samples.

There were slight differences between cooking methods but the differences were significant only for juiciness scores. No significant differences between cooking methods were detected objectively.

References

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