EFFECT OF CARCASS WEIGHT ON SENSORY QUALITY OF YOUNG HOLSTEIN BULLS

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Background

A considerable proportion of beef produced in the UK is a byproduct of the dairy industry. In Northern Ireland, approximately 50% of beef animals slaughtered derive from the dairy herd while nearly 20% of animals are entire bulls. Young animals from this source are generally regarded as low in quality, especially at the lower weight ranges, receiving low EUROP grades for conformation and providing poor remuneration to the farmer. Meat from animals of this type is usually destined for the commodity minced (ground) beef market.
Previous research has studied the effect on the eating quality and other attributes of young bulls of diet and finishing, age at slaughter and genotype (e.g., Sinclair *et al.* 1998, Vestergaard *et al.* 2000). However, little of this research has focused on young dairy animals. This preliminary investigation forms part of a larger investigation on the rearing and use of young dairy bulls for beef production.

Objectives

This work aims to determine the effect of final live-weight of young dairy bulls on the eating quality of the beef from *biceps femoris* (silverside), chosen as it is a commonly used roasting joint of intermediate quality.

Materials and methods

Husbandry and slaughter

Ninety-three weaned Holstein bull calves were purchased from farms in Northern Ireland and housed at the Agricultural Research Institute for Northern Ireland. At approximately 15 weeks of age, calves were grouped into blocks of four animals according to similarity of live weight and age. One animal from each block was allocated at random to one of four treatments with different target slaughter weights, namely 400 (T3), 450 (T4), 500 (T5) and 550 (T6) kg. Animals were housed in pens accommodating between 4 and 9 animals within each slaughter weight treatment group. All animals were offered concentrates (maize meal, sugar beet pulp, vitamin/mineral premix, barley, and soyabean meal) *ad lib* with a restricted quantity of barley straw (nominally 0.5 kg/head/d). Of these animals, 48 were selected for assessment of eating quality, 15 in each of the heavier treatments and only three in T3. Data from this lightest group was excluded from statistical analysis due to the small number of animals.
The animals were slaughtered on seven different dates at the same plant with no electrical stimulation and the sides hung by the Achilles tendon. Treatments T4 to T6 were each slaughtered over four to six of these dates. The silverside joints were removed from the carcass at 24h *post mortem* and vacuum packed.

Preparation of meat

The joints were transported to the laboratory in a refrigerated van and aged at 2ºC for a total of 21 days from slaughter. After this time the joints were frozen and stored at -20ºC for a period of 3 to 4 months. Prior to sensory analysis the *biceps femoris* muscles were cut into 3 pieces cutting across the longitudinal axis of the muscles whilst still frozen, the joints were re-vacuum packed and returned to the freezer. The pieces were denoted A (proximal), B (centre), and C (distal). Only joints A and B were used in this study

Sensory Analysis

Joints were allowed to thaw in their vacuum packs at 4ºC for a period of 24h. Joints A and B (mean weights of 1720 and 2160kg) were prepared for roasting by removal of all fat and epimysium. The joints were browned on all sides before being placed in uncovered stainless steel dishes in an electric fan assisted oven (Falcon) at 180ºC for an estimated cooking time of 30 min per 500g, with start times adjusted to give similar finish times. All the joints were cooked to an internal temperature of 74 ºC. The outer surface was trimmed

from the cooked joints and the inner roast meat cut into portions (30-40g) for sensory analysis. The samples were held in a warm oven (95 to 100°C) before being served warm to the panellists within 5 minutes.
Panellists were volunteers from University and DARD departments who were untrained but had experience of participating in taste panels. The panellists assessed 96 joints from 48 animals over 36 sessions. Samples were allocated to the taste panels sessions using a balanced design (PSA Systems Version 3.3, Oliemans, Punter and Partners, Utrecht, The Netherlands) where each panellist was presented with a total of six samples. Panellists scored the first three samples (from three joints) for the subjective attributes, acceptability of aroma, flavour, texture, and overall acceptability, in this order, using a 10cm line scale anchored at each end (dislike extremely – like extremely) and at 50%. Panellists were advised that the central point differentiated between acceptable and unacceptable. Panellists were also asked to rate the sample on a four point category scale as being unacceptable (1), satisfactory everyday quality (2), better than everyday quality (3), premium quality (4), similar to that used in the Australian MSA system (Polkinghorne *et al.* 1999). Panellists then assessed three more samples from the same joints for the objective attributes, intensity of aroma, intensity of flavour, tenderness and juiciness, again on a 10 cm line scale. Each sample was tested by 10 consumers. Statistical analysis was conducted using a mixed model analysis of variance.

Results and discussion

Table 1 lists the live-weight of the animals used in this study together with those carcass characteristics that might be considered to influence eating quality. The groups of animals achieved their target mean live-weight at slaughter but there was some variation in the weights of individual animals. As expected, increasing live-weight and age gave a slight improvement in EUROP grade and an increase in fat grade and cover. These aspects will be discussed fully elsewhere. Table 2 shows the mean sensory scores for the subjective and objective sensory attributes of *biceps femoris* (silverside) from young Holstein bulls.

Table 1. Characteristics of animals belonging to the four groups used for eating quality assessment.

Treat-ment	No. anim-als	Mean live-weight (kg)	*SD*	Mean carcass weight (kg)	*SD*	Mean age (days)	*SD*	Conformation (EUROP grade)	Mean fat grade	*SD*	Mean fat cover (mm)	*SD*
T3	3	407	*12*	219	*11*	365	*21*	1P, 2O-	2.3	*0.5*	2.7	*1.6*
T4	15	458	*9*	239	*8*	375	*26*	6P, 8O-, 1O+	2.8	*0.4*	2.7	*1.2*
T5	15	502	*30*	267	*15*	389	*33*	4P, 4O-, 7O	2.8	*0.4*	2.3	*0.9*
T6	15	561	*20*	298	*10*	438	*26*	2P,6O-,6O,1O+	2.9	*0.3*	3.1	*0.8*

Effect of liveweight

Only small differences were observed between roast beef from animals reared to different live-weights. There were no significant differences in texture or flavour. Meat from the smaller animals (T4) was, apprently, significantly more juicy but had a less acceptable aroma and was a little less acceptable overall than that from the animals reared to 500 or 550kg (T5, T6). However, the three animals reared to 400kg (T3) did not follow the same trend and the observed effect may be related only to group T4. Sinclair *et al.* (1998) reported that age at slaughter had no significant effect on the tenderness of meat from several muscles, including *biceps femoris*, from young bulls.

Effect of position in muscle

The most significant effect on eating quality was that of joint or position within the *biceps femoris* muscle, with highly or very highly significant effects observed for all sensory attributes. The greatest differences were in aspects of texture. The joint from the proximal portion of the muscle (A) was much more tender than the centre portion (B) and also had more acceptable texture. Differences in overall acceptability reflected this texture difference. Significant but smaller differences in the same direction were also observed for juiciness, intensity of flavour, and acceptability of flavour. Sensory trials with untrained panellists frequently show

Table 2: Effect of carcass weight and position in joint on subjective and objective sensory scores for eating quality of roast beef from *biceps femoris* (silverside) from young Holstein bulls.

	Joint	Treatment (T3)[b]	T4	T5	T6	Mean	Significance[a] (SED) Live-weight	Joint	Interaction
Subjective attributes									
Acceptability	A	(71)	68	69	68	**68**	**	**	*
of Aroma	B	(62)	60	67	68	**65**	(1.29)	(1.50)	(2.15)
	Mean	**(66)**	**64**	**68**	**68**				
Acceptability	A	(64)	64	65	61	**63**	ns	***	*
of Flavour	B	(47)	52	58	58	**56**	(1.41)	(1.75)	(2.41)
	Mean	**(56)**	**58**	**62**	**60**				
Acceptability	A	(68)	65	66	58	**63**	ns	***	***
of Texture	B	(35)	43	50	53	**48**	(1.92)	(2.50)	(3.35)
	Mean	**(52)**	**54**	**58**	**55**				
Overall	A	(65)	65	68	62	**65**	*	***	**
Acceptability	B	(50)	48	56	57	**54**	(1.60)	(1.88)	(2.69)
	Mean	**(58)**	**56**	**62**	**60**				
Objective attributes									
Intensity	A	(50)	54	50	47	**50**	ns	**	**
of Aroma	B	(44)	44	47	47	**46**	(1.42)	(1.64)	(2.35)
	Mean	**(47)**	**49**	**48**	**47**				
Intensity	A	(47)	52	50	46	**49**	ns	**	*
of Flavour	B	(34)	44	43	46	**44**	(1.54)	(1.79)	(2.56)
	Mean	**(41)**	**48**	**46**	**46**				
Tenderness	A	(64)	62	65	57	**62**	ns	***	ns
	B	(28)	49	48	51	**49**	(2.42)	(2.88)	(4.10)
	Mean	**(46)**	**55**	**56**	**54**				
Juiciness	A	(48)	56	51	44	**51**	***	**	*
	B	(33)	50	41	46	**46**	(1.79)	(2.18)	(3.05)
	Mean	**(41)**	**53**	**46**	**45**				

[a] SED = standard error of difference, shown in brackets. *, **, *** = significant at P<0.05, 0.01, 0.001 respectively. ns = P≥0.05
[b] Data from 400kg group were not included in statistics as comprises only 3 animals.

correlation between flavour, juiciness and texture, perhaps due to the difficulty of separating these attributes completely and possibly due to inter-relationships between, for example, juiciness and flavour release. In this study, many of the attributes were highly correlated (P<0.001) with one another even though assessments were conducted on two separate samples. It is interesting that the panellists were able to differentiate between these joints for intensity of aroma and acceptability of aroma. As these attributes were assessed first, before the panellists had taken the sample into their mouths, these differences appear to be small but real and suggest that joint A gave a greater concentration of key odour volatiles when roasted, probably also contributing to the observed difference in flavour.

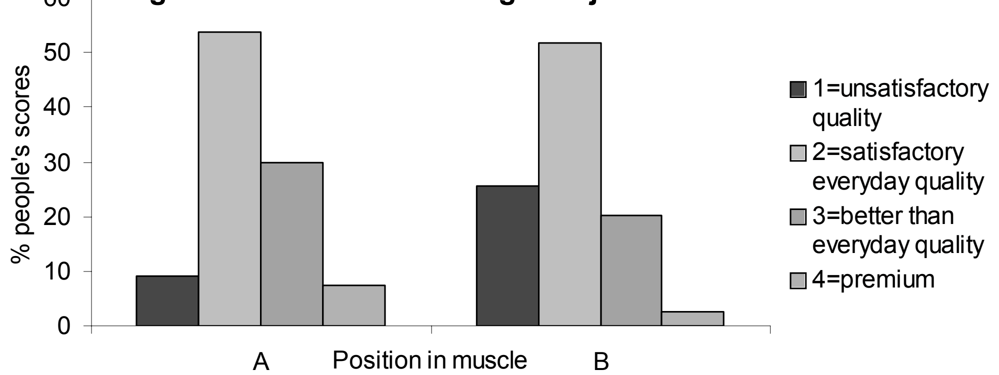
Live-weight x joint interactions

Seven of the eight attributes showed significant joint x live-weight interactions, suggesting that the size of the animal was important for the eating quality differences observed between the joints. Most affected was

acceptability of texture, together with overall acceptability and intensity of odour. However, all the attributes followed a similar trend; joint A scored higher than joint B for the 450kg and 500kg animals but this difference was considerably reduced or removed in the 550kg animals. The data from the three 400kg animals also followed the same trend. Overall, this increased difference between the joints at the lower weights represented both a slight decrease in quality of joint B and a slight increase in the quality of joint A at these lower weights. As the muscles were aged to 21 days, the observed tenderness differences brtween joints may be due to differences in collagen content or sarcomere length. Such differences may be caused by differences in pH/temperature fall and size or fat cover of the muscle, or by differences in muscle development. Table 1 shows that the difference in fat class and cover between treatments T4 to T6 is small and would not appear to explain these results. Further work is required to determine the reason for these effects.
An exaggeration of sensory differences at the lower live-weights was also observed by Vestergard *et al.* (2000). Beef from young bulls reared to 360kg showed a greater difference in eating quality between beef from extensively and intensively reared animals than that from animals reared to 460kg. However, in this case, this effect was attributed to an intensive finishing period given to the older 'extensive' animals.

Satisfaction scores
The satisfaction ratings provide an indication of how the panellists in this trial assessed the overall quality of the *biceps femoris* roast beef presented to them (Figure 1). For both joints, most samples assessed to be 'satisfactory everyday quality' but, for joint A, a higher proportion of assessments were at the higher grades.

Figure 1. Satisfaction ratings for joints A and B



These preliminary results suggest that the eating quality of aged *biceps femoris* from these young dairy bulls is not poorer than that of roast beef joints purchased at retail and assessed previously. This observation concurs with the conclusion of Sinclair et al. (1998) that beef from young bulls, in their case of beef breeds, can be at least as good as the UK standard product. Further studies will be conducted to study the eating quality of a range of muscles from young dairy animals and to determine whether extensive aging is necessary to achieve acceptable eating quality.

Conclusions

This preliminary study indicates that the eating quality of *biceps femoris* (silverside) is affected significantly by the position within the joint but only slightly by live-weight. However, the sensory differences between joints are largely non-existent at 550kg but are exaggerated at the lower live-weights. Further research is needed to establish why this effect occurs and whether it can be managed to enable high quality beef to be obtained from young dairy bulls.

References

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