EFFECT OF FEEDING PERIOD FOR DRY CULL COWS ON CARCASS QUALITY, MEAT QUALITY AND CONSUMER REACTIONS TO LOIN STEAKS

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Background

A major part of the beef marketed for Danish retail consumers originates from dairy cows slaughtered when they are culled from milk production. As these cows are often slaughtered at various stages of lactation and with variable degrees of fatness the meat is often criticised for having a considerable variation in eating quality. Previous research has documented that it is possible to fatten cows during lactation (Liboriussen & Klastrup, 1988), but the potential for dry cows has not been investigated. Furthermore the effect on the eating quality of fattening dry cows has not been investigated thoroughly. The present study comprised two trials. The results from the first trial with 63 cows were reported by Bang et al.(2000). The results of both the first and second trial, including 62 cows in 2002, are reported here.

Objectives

The purpose was to investigate the effect of feeding dry Danish Friesian cull cows for 0, 2 or 4 months on carcass- and meat quality and consumer reactions to loin steaks.

Methods

The experimental design of the second trial was almost identical with the first trial described by Bang et al.(2000) so only the modifications are shown here. In total 125 lactating Danish Friesian cows, culled for different reasons, were purchased from commercial dairy herds. Three treatment groups were established: a control group slaughtered after 7 days of drying off (C, n=43, mean age 47mth)., a group dried off for av.11 days and finishing-fed for a further 58 days (F2, n=41, mean age 51mth), and a group dried off for av.10days and finishing-fed for a further 122 days (F4, n=41, mean age 49mth). Half of each group was first lactation or older cows, respectively. Cows were housed in tie-stalls. In the drying-off period, the cows had free access to barley straw and water. In the finishing period, the cows had free access to a total mixed ration described by Vestergaard & Madsen (2000).

The cows were slaughtered with optimal procedures as described by Bang et al. (2000). A semi-commercial boning of the right half carcass was performed and weight of cuts, fat trim and bone was recorded. Samples were taken from the LD muscle at the 12th and 13th rib and at the 1st lumbar vertebra for laboratory analyses. Sirloin samples were taken for sensory assessment. LD samples were analysed according to methods described by Bang et al.(2000) for: pH, Hunterlab-colour (L, a and b), intramuscular fat (IMF), total pigment content using the Hornsey method, and Volodkevich shear force of samples cooked to a core temperature of 72°C. Sirloins for sensory assessment were vacuum packed, aged for 16 days at 4°C and then stored at –20°C until assessment could take place. The sirloins were thawed at 4°C for 20-21 hours, sliced in 23 mm steaks and trimmed completely for subcutaneous fat and tendons. The steaks were fried to a core temperature of 62-65°C. Trimming and cooking loss were recorded. The panel consisted of 8 trained assessors who evaluated the tenderness, juiciness and meat flavour on a scale from 0 to 15 according to an increasing intensity of the trait. The panel mean was calculated for each trait and sample.

Dissection, sensory and meat analysis results were analysed with Proc Mixed in SAS (Littell et al., 1996) using the following statistical model: $Y_{ijklm} = \mu + \alpha_i + \beta_j + (\alpha_i * \beta_j) + \delta_m + \gamma w_k + \varepsilon_{ijklm}$ where Y_{ijklm} is the analysed trait, μ is the overall least squares mean, α_i is the fixed effect of the i´th treatment (0,2,4), β_j is the fixed effect of the j´th lactation (1,>1), δ_m is the fixed effect of year (2000,2002), γ is the linear regression coefficient of the weight (w_k) of the individual cow at the beginning of the experiment within lactation groups (young or older cows) and ε_{ijklm} is the random residual.

In both trials aged (16d. 4°C), trimmed- and individually vacuum packed frozen striploin steaks were evaluated by consumers as described by Grunert et al.(2002). In 2000 and 2002 steaks of 20mm and 23mm thickness were used and tested by 160 and 138 consumers, respectively, from the Roskilde area. The consumer test included three parts: 1. An evaluation of quality expectations based on pictures of representative uncooked steaks from the three treatment groups. 2. A standardized evaluation of cooked steaks (incl. salt, pepper and with a core temperature of 65°C) with all three treatment groups presented on one plate in each session using the sensory lab booths, and 3. An in-home evaluation, where the consumers received steaks from the three treatment groups to be prepared to their own liking and to evaluate the steaks in three different meals. Consumer questionnaires were quite elaborate with many quality dimensions and only parts of the data are shown here. A seven-point scale was applied to assess tenderness, juiciness, taste, leanness and total evaluation.

Results and discussion

The main effects of feeding period on carcass and meat quality are presented in Table 1. Feeding of the dry cows for 2 or 4 months showed a marked effect on the carcass size as well as on the composition of the carcass. Finishing the cows for 2 or 4 months increased the carcass weight by 46 and 88 kg, respectively. Two months of feeding increased the dressing percentage from 45.1 to 47.2% while there was no significant effect of feeding for a further two months. EUROP conformation score increased one subclass scale for each 2 months of feeding whereas EUROP fatness increased with almost one main class. The amount of saleable meat increased approx. one percentage unit for each 2 months increase in feeding time. Feeding also increased the cross sectional area of the rib eye significantly. Factors expressing the fat deposition of the carcass (amount of caul and kidney fat, fat thickness over rib eye, dissection of loin) all showed a marked increase in the amount of fat deposited in the carcass with increasing time on feed.

The C-cows had 2.6% IMF while the F2-cows had 3.7% and the F4-cows had 5.3%. Shear force tended to be lower in fed cows, but the sensory panel did not detect a significant improvement in tenderness or juiciness in F2 and F4 cows, although the trend was similar to changes in shear force. The lightness was slightly increased with feeding, confirmed by slightly lower pigment content. Due to the high amount of subcutaneous fat deposited (in F2 and F4), it was decided to trim the steaks before cooking – only recorded in the first trial. This resulted in a trim loss of 39% in the F4 group and 28 to 31% in the two other groups. The cooking loss was 17 to19%, which is not unusual for this category of beef. Overall, the meat in all three groups had a very fine texture (mean Volodkevich shear force varied from 5.1 to 5.9 kg), which is at the same level as steers most commonly having an excellent meat quality. Surprisingly the meat quality of the control group was almost as good as the two fed groups and we speculate that the very low feeding level in the drying off period may have influenced the meat tenderness probably by elevating the in vivo protein breakdown.

The consumer test results were similar for the two trials (tested with *t-test).* From the visual assessments the consumers expected the meat to be less tender with increased feeding time, but experienced the opposite when cooking at home. For both juiciness and taste their expectations increased from C to F2 but decreased from F2 to F4. The consumers visually found the meat less lean with increased feeding time and their total visual expectations were reduced. At home the good taste increased by feeding, in line with the increase found in meat flavour by the sensory panel. Both tenderness and juiciness increased by feeding, when evaluated at home, but the increase in total liking of the meat was more clear going from C to F2 than from F2 to F4. Results showed that the visual expectations dropped with increased feeding and lower leanness of the meat, which is interpreted as a negative quality indicator. The experienced quality, however, increased with feeding and at home consumers found the meat from F2 and F4 significantly more tender, juicy and tasty than meat from C.

Presented with the standardized cooked steaks, the consumers identified little difference between C, F2 and F4 with trends even less clear than in the sensory test. This unexpected result may be explained by the inability of the standardized cooking method to satisfy individual consumer preferences of cooking, e.g. the degree of doneness. Thus only 63% of the consumers found that the standardized cooking was adequate relative to 89% when they performed the cooking themselves.

With perspective to both sensory panel and consumer results, it was noteworthy that the overall eating quality of the steaks was at a high level, and improved with feeding especially for meat flavour. The increase in IMF with 2 or 4 months feeding would lead to an expectation of an even further improved eating quality. The relative good eating quality of the C-group was achieved using optimal slaughter procedures and aging, and may not be reached without these precautions. Considering the fat scare among many consumers, and their misinterpretation of the role of IMF, it is likely that steaks from fed cows would experience a difficult sale in the supermarket counter, unless they are accompanied by clear labelling and understandable consumer information. The production economic aspects, both for the farmer and for the processing industry, which should face the cost of excessive fat trim and organ fat at low value, also have to be justified by the increase in muscle growth and probably result in a necessary higher price of the meat. With international trade and competition of e.g., steer meat of good quality, it may be difficult to exploit the potential to improve the quantity and quality of meat from cull dairy cows.

Table 1. Carcass and meat quality. Least square means by treatment groups.

	Treatment			Level of significance[1]
	C	F2	F4	
Number of animals	43	41	41	-
Carcass weight	249[a]	295[b]	337[c]	***
Dressing percentage	45.1[a]	47.3[b]	48.5[c]	***
EUROP conformation	2.3[a]	3.4[b]	4.4[c]	***
EUROP fatness	2.0[a]	3.0[b]	3.7[c]	***
Hindquarter (kg)	59.0[a]	67.8[b]	76.0[c]	***
Caul + kidney fat (kg)	10.3[a]	16.1[b]	26.8[c]	***
Rib eye area (cm^2)	49.5[a]	55.0[a]	61.3[b]	***
Fat thickness (cm)	0.4[a]	0.5[a]	1.0[b]	***
Dissection of loin:				
Lean, %	62.2[a]	59.9[b]	55.4[c]	***
Fat, %	12.1[a]	18.1[b]	25.7[c]	***
Bone, %	25.8[a]	22.0[b]	18.9[c]	***
Saleable meat, %	73.3[a]	74.6[b]	75.4[c]	***
Lightness (L)	32.6[a]	33.9[ab]	35.0[b]	**
Redness (a)	20.6[a]	21.3[a]	21.8[b]	*
Yellowness (b)	9.5[a]	10.1[b]	10.4[b]	**
Intramuscular fat, %	2.6[a]	3.7[b]	5.5[c]	***
Shear force (kg)	5.9[a]	5.7[ab]	5.1[b]	0.06
Pigment (ppm)	217[a]	204[b]	204[b]	*
Tenderness (0-15)	8.5	9.0	9.2	Ns
Juiciness (0-15)	10.2	10.4	9.9	Ns
Meat flavour(0-15)	8.5[a]	9.0[b]	9.4[c]	***
Trim loss, % (n=53)	28.2[a]	30.8[a]	39.2[b]	***
Cooking loss, %	16.0[a]	17.4[b]	17.5[b]	***

[1] ns: p≥0,05; *: p<0,05; **: p<0,01; ***p<0,001
[abc] Means within a line with different letters are different p<0,05)

Conclusions

Feeding cull cows for 2 or 4 months resulted in a marked improvement of carcass weight, EUROP conformation and fatness, rib eye area and percentage of saleable meat, but did also increase the fattening of the carcasses considerably. In general the eating quality was very fine and moderately improved by feeding which is expressed in shear force, sensory assessments and consumer tests. It is surprising that the overall eating quality of the control cows was at a relative high level compared to the cows fed for 2 or 4 months. Consumer tests showed lower expectations of steaks from the fed cows with high visible IMF and subcutaneous fat, but the consumers rated with their own cooking the steaks from fed animals more tender, juicy and tasty than meat from non-fed cows.

Table 2. Consumer evaluations of quality expectation (I) prior to cooking, and experienced quality with standardized (S) or in home cooking (H) of loin steaks. Simple means for the trial in 2002.

Quality trait[3] and test		Treatment			Level of significance of treatment[1,2]		
		C	F2	F4	E	L	Q
Tenderness[3]	I	4.9	4.9	4.4	*	*	Ns
	S	4.2	4.5	4.4	Ns	Ns	Ns
	H	4.3	4.8	5.2	***	***	Ns
Juiciness[3]	I	4.4	5.0	4.7	***	Ns	***
	S	4.5	4.4	4.5	Ns	Ns	Ns
	H	4.6	4.7	5.1	***	***	Ns
Taste[3]	I	4.9	5.2	4.4	***	*	***
	S	4.7	4.8	4.8	Ns	Ns	Ns
	H	4.6	4.8	5.2	***	***	Ns
Leanness[3]	I	6.0	3.6	2.2	***	***	***
	S	5.3	5.3	5.3	Ns	Ns	Ns
	H	4.9	4.4	3.6	***	***	Ns
Total[4]	I	4.9	4.7	3.2	***	***	***
	S	4.4	4.6	4.6	Ns	Ns	Ns
	H	4.4	4.8	4.8	0.09	*	Ns

[1]See table 1 subscript
[2] Repeated measures analysis of variance with polynomic contrasts. E: Effect, L:Linear, Q: Quadratic
[3]Seven-point scale where 1: not very.... 7: extremely ....
[4]Seven-point scale where 1: total dislike 7:like very much

References

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