EATING QUALITY OF FILET AND ROUND FROM GRAZING HOLSTEIN BULLS AND LIMOUSINE X HOLSTEIN BULLS AND HEIFERS

Margrethe Therkildsen[1*] and Mogens Vestergaard[2]

[1]Department of Food Science, Science and Technology, Aarhus University, DK-8830 Tjele, Denmark

[2]Department of Animal Science, Science and Technology, Aarhus University, DK-8830 Tjele, Denmark

*Margrethe.Therkildsen@agrsci.dk

Abstract – Production of organic beef from young cattle is not very developed in Denmark, in spite of a well-established organic dairy production with male off-spring. These calves are sold to conventional production, because of low performance in organic production systems. The purpose of this study was to test a concept for production of organic beef based on crossbred animals from dairy cows sired with a beef breed. The experiment included a comparison between spring-born pure-bred Holstein bulls (HB), cross-bred Limousin x Holstein bulls (CB) and heifers (CH), 15 of each group. After weaning the calves were raised outdoor on pasture the 1st summer and indoor on a low energy grass-haylage ration over winter followed by pasture the 2nd summer and slaughter at a fixed age of 16.9 mo. CB showed an improved daily gain, EUROP conformation, but not fatness compared with HB, which was inferior compared with the CH. A sensory evaluation showed more intense aroma and taste characteristics of the loin from HB compared with the other groups, whereas the tenderness of the loin and round from both HB and CB were inferior compared with CH, and is expected to be too low to fulfil consumer expectations of tender beef.

I. INTRODUCTION

Production of organic beef from young cattle is not very developed in Denmark even though there is a well-established organic dairy production which per se produces male off-spring. Production of organic beef requires among other things that the animals are raised outdoor during 6 months of the year and with large quantities (60% or more) of roughage in the diet. These rules are two of the major constraints for the development of the organic beef from young cattle as the pure-bred dairy breeds do not perform very well on diets rich in pasture and roughage and specifically classify rather poor on the EUROP conformation scale. The consequence is that the male off-spring from organic dairy production is sold for conventional beef production. Introduction of beef breed semen in the dairy herd could contribute with a better growth rate and higher carcass weight, i.e., higher muscularity of the crossbred animals, which in terms would improve overall production efficiency. Keeping offspring bulls as entire males is an alternative to utilize their full growth potential and also to address the welfare advantage obtained without castration and test if handling of bulls could be practised. The purpose of the present study was to test a prototype concept for production of organic beef from young cattle (entire males and heifers), based on crossbred animals from dairy cows sired with a beef breed, feeding a low energy diet during winter and high yielding clover-grass swards for summer grazing. In this paper, the effect of the prototype concept for efficient production of organic beef from young cattle on eating quality traits is presented.

II. MATERIALS AND METHODS

The study included spring-born crossbred Limousine x Holstein bulls (CB) and heifers (CH), 15 of each, which were compared with 15 Holstein bulls (HB). The calves were purchased 20 days of age and slaughtered at the age of 16.9 month. The calves were kept indoors in groups of 5 animals of the same treatment group until weaning at 3 month. Average daily gain from birth to weaning was 724 g/d and not different between treatment groups. Calves were gradually introduced to a grass-silage based ration from 3 to 4 month, and were then raised on a mixed ryegrass-white clover pasture from 4 to 7 month (1st summer). From late October till mid-May, animals were kept in the same groups of 5 animals and were housed in deep litter stalls with free

access to a low energy grass-haylage ration. The 2nd summer, the animals were grazing in a rotational paddock system (18 paddocks) in the same groups of 5 animals (9 groups) and generally moved to a new sward every week. Animals were slaughtered directly from pasture in mid-August (3 x 5 animals, one block) or early September (6 x 5 animals, two blocks) at a commercial slaughter plant (Danish Crown, Aalborg). The carcasses were weighed and classified according to the EUROP scale for conformation and fatness. Twenty-four hours post mortem the pH was measured in filet (*M. longissimus dorsi*) and Round (*M. semimembranosus*) in 8 animals of each treatment group and the two muscles were sampled for ageing at 4°C for additional 13 days. Following ageing the muscles were stored at -20°C until sensory evaluation of the meat 3 months later.

The eating quality was evaluated by a nine-member trained sensory panel on an unstructured scale from 0 to 15, with 0 representing minor aroma and taste characteristics and tough meat and 15 representing intense aroma and taste characteristics as well as tender meat. The filet (LD) was prepared as 20 mm steaks on a frying pan to an internal temperature of 63°C and the round (SM) was prepared as a roast in an oven (100°C) to an internal temperature of 63°C.

Data were analyzed using the MIXED procedure in Statistical Analysis System version 9.4 with treatment group and block and their interaction as fixed effects. The analysis of the sensory data included sensory assessor as repeated measurement in the model.

III. RESULTS AND DISCUSSION

The production and slaughter quality characteristics are presented in table 1. The crossbred bulls responded as expected with a higher daily gain in general, and specifically during the 2nd summer the crossbred bulls showed the potential for a larger gain, even on pasture with an increase of 26% compared with the purebred Holstein bulls. The crossbreeding also improved the EUROP conformation markedly, and the crossbred heifers classified better than purebred bulls. The growth rate of HB on pasture is similar to what have been obtained earlier (1). The improved growth of beef crosses compared with HB has also been obtained by others (2, 3), but depending on the beef breed this is not always the case (4, 5). On the other hand, there was no difference in fatness of the two groups of pasture-fed bulls, which were both too low and caused a penalty in the payment, whereas the crossbred heifers had an acceptable fat cover. The pH measured 24h post mortem in the filet and round did not differ between the treatment groups.

Table 1 Production and slaughter quality characteristics of grazing Holstein bulls (HB) and Limousine x Holstein bulls (CB) and heifers (CH)

	HB	CB	CH	SEM	P-value
Average daily gain 2nd summer, g/d	1081^{b}	1357^{a}	847^{c}	50	0.001
Average daily gain from birth to slaughter, g/d	948^{b}	1018^{a}	841^{c}	16	0.001
Carcass weight, kg	272^{b}	315^{a}	249^{c}	4.5	0.001
EUROP conformation	3.0^{c}	7.0^{a}	5.3^{b}	0.15	0.001
EUROP fatness	1.0^{b}	1.2^{b}	2.9^{a}	0.07	0.001
pH_{24} LD	5.88	5.61	5.55	0.10	0.27
pH_{24} SM	5.62	5.56	5.59	0.03	0.44

[abc]Means within a row without common superscript letters are different at $P < 0.05$.

At the sensory evaluation the panel recognised no variation in the aroma and the taste of SM (Table 2) whereas the LD from HB had more gamy ($P < 0.003$) and liver ($P < 0.02$) aroma and more gamy ($P < 0.004$) and bitter ($P < 0.001$) and less meaty ($P< 0.002$) taste compared with CB and CH (Table 3). Variation in aroma and taste between breeds has been recognised by others (6, 7), but in the present case the characteristic of the HB filet may be more pronounced because of the pasture-feeding (8). The texture of both cuts was affected by the sex of the animals, thus the tenderness and chewing time was inferior in cuts from HB and CB compared with CH ($P < 0.04$) (Table 2 and 3).

Comparisons of texture traits between meat from heifers and bulls often come out in the favour of the heifers (9), but not always (7). In the present study some of the difference may be explained by a difference in fat content, which may be expected from the difference in fatness score. The tenderness score of 5.7 and 5.2 for SM and 6.2 and 6.1 for LD from HB and CB, respectively, is

expected to be too low to fulfil consumer expectations of tender beef. In other studies a negative effect on meat tenderness has also been seen with animals slaughtered directly from pasture in comparison with animals either offered concentrate at pasture or fed indoor with mainly concentrate before slaughter (8,10). This can be related to a positive relationship between daily gain prior to slaughter and tenderness development post mortem (11) but also to a predisposition of the bulls held in a free range system for fighting and stress prior to slaughter, with negative consequences for the meat quality.

Table 2 Eating quality of round (SM) from grazing Holstein bulls (HB) and Limousine x Holstein bulls (CB) and heifers (CH)

	HB	CB	CH	SEM	P-value
Aroma					
Meat	5.42	5.45	5.93	0.34	0.51
Acidic	4.05	3.85	4.20	0.18	0.41
Metal	4.01	3.64	4.04	0.35	0.64
Liver	1.73	1.31	1.81	0.24	0.31
Game	2.79	2.53	2.71	0.24	0.71
Taste					
Meat	5.84	6.05	6.32	0.26	0.43
Acidic	5.23	4.87	5.16	0.16	0.28
Game	2.91	2.76	2.57	0.26	0.65
Sweet	3.38	3.13	3.00	0.17	0.28
Liver	1.29	1.62	1.71	0.22	0.23
Metal	4.27	4.03	4.28	0.31	0.73
Bitter	3.49	2.90	3.01	0.22	0.16
Texture					
Chewing resistance	7.12	7.59	6.13	0.53	0.098
Tenderness	5.71^{b}	5.18^{b}	7.67^{a}	0.64	0.004
Chewing time	9.53^{ab}	9.97^{a}	8.25^{b}	0.52	0.035
Juiciness	7.33	6.31	7.05	0.50	0.072

[ab]Means within a row without common superscript letters are different at $P < 0.05$.

IV. CONCLUSION

In conclusion crossbred Limousine X Holstein bulls and heifers may be an alternative to purebred Holstein bulls in organic beef production of young cattle because of the improved gain and carcass conformation, aroma and taste, but the fatness and texture of the crossbred bulls need to be improved through changes in the production strategy, especially feeding prior to slaughter, and in the pre and post mortem handling.

Table 3 Eating quality of filet (LD) from grazing Holstein bulls (HB) and Limousine x Holstein bulls (CB) and heifers (CH)

	HB	CB	CH	SEM	P-value
Aroma					
Meat	5.81	6.48	6.61	0.29	0.14
Acidic	3.03	3.45	3.41	0.17	0.067
Metal	2.72	2.51	2.23	0.34	0.38
Liver	2.15^{a}	1.76^{ab}	1.14^{b}	0.34	0.019
Game	3.45^{a}	2.19^{b}	1.55^{b}	0.17	0.003
Taste					
Meat	5.49^{b}	6.57^{a}	7.00^{a}	0.27	0.002
Acidic	4.37	5.15	5.04	0.43	0.11
Game	3.51^{a}	2.05^{b}	1.43^{b}	0.53	0.004
Sweet	3.50	2.83	2.80	0.34	0.054
Liver	2.07	1.52	1.33	0.27	0.12
Metal	3.52	3.66	3.24	0.42	0.60
Bitter	4.18^{a}	3.42^{b}	2.80^{b}	0.28	0.001
Texture					
Chewing resistance	6.69	6.61	4.81	1.41	0.10
Tenderness	6.17^{b}	6.12^{b}	9.49^{a}	1.84	0.017
Chewing time	8.61^{a}	8.25^{a}	5.54^{b}	1.70	0.018
Juiciness	8.37	8.09	8.51	0.35	0.69

[ab]Means within a row without common superscript letters are different at $P < 0.05$.

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