Eating quality of meat from organic beef based on crossbred animals

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Production of organic beef from young cattle is not very developed in Denmark, in spite of a well-established organic dairy production that could deliver bull calves for use in organic beef production. Instead these calves are sold to conventional beef producers, 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 results show that crossbred Limousine X Holstein bulls and heifers may be an alternative to purebred Holstein bulls in organic beef production of young cattle because of improved gain and carcass conformation, aroma and taste. However, 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.

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 that could be utilized for organic beef production. 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. Furthermore, keeping the bulls as entire males is a way to utilize the full growth potential and also to address the welfare advantage obtained without castration As grazing is the sole feed during summer periods, it is critical that pasture and sward are of high quality to assure a high growth rate of the animals. 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 giving access to high yielding clover-grass swards for summer grazing.

Animals in the study

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 from milk replacer 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 or early September 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 additional ageing for 13 days at 4◎C. Following ageing the muscles were stored at -20◎C until sensory evaluation of the meat 3 months later.

Eating quality was evaluated

The eating quality was

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

	HB	CB	CH	SEM
Carcass weight, kg	272[b]	315[a]	249[c]	4.5
EUROP conformation	3.0[c]	7.0[a]	5.3[b]	0.15
EUROP fatness	1.0[b]	1.2[b]	2.9[a]	0.07
pH_{24} LD	5.88	5.61	5.55	0.10
pH_{24} SM	5.62	5.56	5.59	0.03

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

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
Taste				
Meat	5.84	6.05	6.32	0.26
Game	2.91	2.76	2.57	0.26
Sweet	3.38	3.13	3.00	0.17
Liver	1.29	1.62	1.71	0.22
Metal	4.27	4.03	4.28	0.31
Bitter	3.49	2.90	3.01	0.22
Texture				
Tenderness	5.71[b]	5.18[b]	7.67[a]	0.64
Chewing time	9.53[ab]	9.97[a]	8.25[b]	0.52
Juiciness	7.33	6.31	7.05	0.50

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

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
Aroma				
Meat	5.81	6.48	6.61	0.29
Metal	2.72	2.51	2.23	0.34
Liver	2.15[a]	1.76[ab]	1.14[b]	0.34
Game	3.45[a]	2.19[b]	1.55[b]	0.17
Taste				
Meat	5.49[b]	6.57[a]	7.00[a]	0.27
Game	3.51[a]	2.05[b]	1.43[b]	0.53
Sweet	3.50	2.83	2.80	0.34
Liver	2.07	1.52	1.33	0.27
Metal	3.52	3.66	3.24	0.42
Bitter	4.18[a]	3.42[b]	2.80[b]	0.28
Texture				
Tenderness	6.17[b]	6.12[b]	9.49[a]	1.84
Chewing time	8.61[a]	8.25[a]	5.54[b]	1.70
Juiciness	8.37	8.09	8.51	0.35

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

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.

Production and carcassr quality

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. Crossbred heifers gained 22% less than Holstein bulls during 2nd summer. The crossbreeding also improved the EUROP conformation markedly, and the crossbred heifers classified better than purebred bulls (Table 1).

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).

At the sensory evaluation the panel recognised no variation in the taste of SM (Table 2) whereas the LD from HB had more gamy and bitter and less meaty taste compared with CB and CH (Table 3).

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 (Table 2 and 3).

Comparisons of texture traits between meat from heifers and bulls often favour the heifers, but not always. In the present study some of the difference may be explained by the difference in fat content based on 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. This can be related to a positive relationship between daily gain prior to slaughter and tenderness development post mortem 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 final meat quality.

Crossbred animals may be an alternative

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.

More information

Read more about the Organic RDD project SUMMER at: http://www.icrofs.dk/Sider/Forskning/organic-crdd_summer.html

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