

EATING QUALITY OF HOLSTEIN BULL CALVES FED ONLY GRASS OR ONLY HERBS MATCHES THAT OF CONCENTRATE-FED VEAL CALVES

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Abstract – The experiment aimed at elucidating the effect of purely grass or herb feeding of Holstein bull calves prior to slaughter on the color, fatty acids and vitamin composition and eating quality of the meat in comparison with traditional rosé veal calves fed a concentrate-based diet. Eleven calves were fed purely grass (Grass, n=6) or purely herb based green feed (Herb, n=5) for 6 weeks before slaughter at 10 months old. Six 9-10 months old rosé veal calves were also included in the analyses (Con). Seventy-two h pm *M. longissimus dorsi* (LD) and *M. semimembranosus* (SM) were removed and the color traits L*, a* and b* were measured, with no difference between the feeding strategies. The muscles were aged for additional 7 days, before sensory analysis. Except for more meat flavor and juiciness in LD and less sweet aroma in SM from Herb calves compared with the Grass and Con, there were no significant differences in the sensory profile. The meat from Herb calves contained less oleic acid, and more linoleic acid, α -linolenic acid, α -tocopherol and β -carotene compared with the Con and with the Grass in between. The (n-6)/(n-3) ratio improved from 8.6 for Con to 4.4-5.4 for Herb and Grass calves.

Key Words – Organic beef, meat quality, fatty acids, veal

I. INTRODUCTION

Organic dairy production is well established in Denmark, and has the potential to grow even bigger as more and more organic dairy products are exported [1]. However, one issue which is not dealt with in the dairy production is the bull calves born in these herds. The organic rules require that the bull calves are raised outdoor at least 6 months a year in Denmark, and on large quantities of roughage in the diet. These rules are usually mentioned as the main reason for not including the production of beef from these bull

calves in the organic production, because of extra labor costs, expected lower growth rate, difficulties in raising bulls outdoor, possibly lower meat quality and lack of sufficiently high organic premium payment for the carcass. Instead the bull calves are sold to conventional production of rosé veal calves fed a concentrate-based diet [2]. However, this practice does not fulfill the organic principles on sustainability and wholesomeness. There are a few studies with bull calves and other beef cattle raised organically, but the question is if varieties of the pasture or sward is reflected in the meat and detected as variation in the chemical composition and taste.

The present study aimed at elucidating if Holstein bull calves fed either purely grass or purely herbs prior to slaughter would differ in meat quality traits, fatty acid composition and sensory profile and if they differed in quality aspects from concentrate-fed veal calves.

II. MATERIALS AND METHODS

Twelve Holstein bull calves raised on a concentrate-based diet until the age of 8 months were moved to the experimental barn at Aarhus University Foulum, and fed either purely grass (Grass, n=6) or purely herb-based green feed for eight weeks (Herbs, n=6). After the first two weeks of adjustment the diet consisted only of fresh grass (perennial ryegrass) or herbs (weight based composition approximately 70 % English plantain and 30 % mix of sainfoin, melilot, salad burnet and yarrow) cut daily and offered every morning after removing the refusals from the day before. The bull calves were housed and fed in the two groups. One calf from the Herb-group suffered from chronic pneumonia and was excluded from the data. The experiment lasted

for the final 6 weeks, in which the calves were weighed twice at the beginning of the period and twice at the end of the period, before slaughter at a commercial slaughter plant (Danish Crown, Aalborg, Denmark). At the day of slaughter six carcasses from traditionally 9-10 months old rosé veal calves were included as a control group (Con).

After slaughter the carcasses were weighed and classified according to the EUROP system, and pH and temperature were measured 2 and 72 h post mortem in the *M. longissimus dorsi* (LD). At 72 h post mortem LD and *M. semimembranosus* (SM) were removed from both sides and used for meat quality assays and sensory analysis.

From LD and SM samples were removed for color determination with Minolta [3], fatty acid composition according to method described in [4], α -tocopherol and β -carotene according to methods described in [5] and sensory quality of meat after 10 days of ageing. The meat was stored at -20°C before analysis of the traits. For the sensory analysis, LD were prepared as steaks to an internal temperature of 63°C on a frying pan, and SM were prepared as roasts in an oven (100°C) to an internal temperature of 63°C. A 9-membered trained panel evaluated the aroma, flavor and texture traits of the meat as described earlier [6].

Data were analyzed using MIXED procedure in Statistical Analysis System version 8.2.

III. RESULTS AND DISCUSSION

The bull calves offered either grass or herb based green feed were slaughtered at a live weight of 363 kg and 349 kg, respectively, at 10 months old (Table 1). The last 6 weeks the daily gain were close to 1 kg/day, which is below the average daily gain of rosé veal calves but similar to gains of bull calves raised on clover-grass pasture [7]. The specialized production of rosé veal calves requires that the calves are slaughtered before 10 months old and with a carcass weight above 185 kg, and a EUROP conformation above 3.0 to obtain the premium. The Grass and Herb feeding resulted in

carcass weights of 178 kg and 177 kg, respectively, which were not significantly different from the 6 rosé veal calves (197 kg) which were randomly chosen as control calves among the rosé veal calves slaughtered the same day. The fatness and color classification did not differ between the three groups, whereas the Con calves classified 1 EUROP conformation score higher than Grass and Herb calves ($P < 0.004$). The pH measured in LD after 2 and 72 h did not differ between the three groups (Table 1).

Table 1 Production and slaughter quality characteristics of bull calves fed either purely grass (Grass) or herb based green feed (Herb) compared with rosé veal calves (Con)

Feeding	Grass	Herbs	Con	SEM	P-value
Live weight at slaughter, kg	363	349		16.2	0.55
Daily gain, g/d	987	969		66	0.84
Carcass weight, kg	177.5	176.7	196.8	6.9	0.10
Dressing percentage, %	49.0	50.7		0.68	0.09
EUROP conformation	2.73 ^a	2.78 ^a	3.69 ^b	0.19	0.004
Fatness	1.67	1.67	2.17	0.20	0.15
Color	3	3	3	0.15	1
pH 2 h pm	6.63	6.62	6.65	0.04	0.91
Temp 2 h pm, °C	34.4	33.5	35.0	0.78	0.42
pH 72 h pm	5.86	5.82	5.92	0.06	0.53
Temp 72 h pm, °C	2.33 ^a	2.50 ^a	2.75 ^b	0.07	0.002

^{a,b} values with different superscript are significantly different ($P < 0.05$)

The color traits L*, a* and b* were measured 72 h post mortem after 1 h blooming and showed no variation between feeding groups on either LD or SM (data not shown). This contrast with [8], who saw a higher L*, a* and b* value in concentrate fed bull calves compared with pasture fed bull calves, however an effect of exercise contributed to this difference as the concentrate-fed bulls were housed in tie-stalls.

At the sensory evaluation only few differences were found between the feeding groups (Table 2). There was no variation in the characteristics describing odour of either muscle, whereas the meat flavor was significantly more intense in the LD from Herb calves compared with Grass and

Con, but in SM the meat flavor tended to be more intense in the Grass calves compared with the Con calves with Herb calves in between ($P < 0.07$). No other flavor traits differed between the feeding groups. The texture traits in LD were described with hardness at 1. bite, juiciness and tenderness. LD from Herb calves were more juicy compared with Grass and Con calves ($P < 0.014$). In SM the texture were described with the traits juiciness and tenderness, but there were no indications of differences between the feeding groups.

Table 2 Sensory characteristics of *M. longissimus dorsi* and *M. semimembranosus* from bull calves fed purely grass (Grass) or purely herb based green feed (Herb) compared with rosé veal calves (Con)

Feeding	Grass	Herbs	Con	SEM	P-value
<i>M. longissimus dorsi</i>					
Odour					
Meat	6.34	7.58	6.50	0.47	0.16
Acidic	5.19	5.19	5.33	0.18	0.82
Sweet	3.48	3.45	3.45	0.11	0.99
Metal	4.78	5.04	4.51	0.23	0.29
Flavour					
Meat	7.06 ^a	8.23 ^b	7.22 ^a	0.30	0.03
Acidic	6.16	6.36	5.83	0.16	0.08
Sweet	4.25	4.21	4.19	0.16	0.97
Bitter	3.96	3.86	3.94	0.28	0.96
Metal	4.62	4.88	4.50	0.22	0.48
Texture					
Hardness at 1. bite	5.98	5.34	7.00	0.62	0.19
Juiciness	7.65 ^a	8.31 ^b	7.5 ^a	0.18	0.014
Tenderness	6.61	7.53	5.61	0.82	0.29
<i>M. semimembranosus</i>					
Odour					
Meat	4.56	4.82	4.40	0.14	0.13
Acidic	4.19	3.90	3.99	0.16	0.42
Sweet	3.47	2.87	3.17	0.23	0.21
Liver	0.68	0.63	0.59	0.10	0.83
Metal	2.54	2.50	2.10	0.17	0.16
Flavour					
Meat	6.14	5.79	5.48	0.18	0.07
Acidic	5.85	5.99	6.46	0.27	0.30
Sweet	3.36	3.19	3.03	0.12	0.19
Liver	0.90	0.98	0.75	0.22	0.75
Bitter	3.35	3.42	3.72	0.22	0.49
Metal	4.11	4.24	4.50	0.33	0.70
Texture					
Juiciness	5.89	6.46	6.91	0.52	0.40
Tenderness	7.99	7.79	7.47	0.62	0.84

^{a,b} values with different superscript are significantly different ($P < 0.05$)

In an earlier study with young bull calves raised on clover-grass pasture compared with indoor

raised concentrate fed young bulls a decreased tenderness in LD, *M. semitendinosus* and *M. supraspinatus* were observed and also higher scores for off-flavor in the grass fed bulls [6]. This was not the case in the present experiment, where the grass/herb fed calves scored just as good in all traits evaluated by the sensory panel. It cannot be ruled out if the previous results also relate to the different exercise level of the bulls.

In contrast to few significant differences in the sensory characteristics of the meat, the analysis of fatty acid composition and content of β -carotene and α -tocopherol showed a clear effect of the feeding strategies on the vitamins and oleic, linoleic and α -linolenic acid content as well as an improved (n-6)/(n-3) ratio by grass and herbs feeding (Table 3).

Table 3 Content of oleic, linoleic and α -linolenic acid relative to total fatty acids, (n-6)/(n-3) ratio and content of β -carotene and α -tocopherol in *M. longissimus dorsi* and *M. semimembranosus* from bull calves fed purely grass (Grass) or purely herb based green feed (Herb) compared with rosé veal calves (Con)

Feeding	Grass	Herbs	Con	SEM	P-value
<i>M. longissimus dorsi</i>					
C18:1n-9, %	29.1	26.0	30.6	1.5	0.15
C18:2n-6, %	13.7	16.7	14.5	2.0	0.58
C18:3n-3, %	2.23 ^b	3.26 ^a	0.93 ^c	0.25	0.001
(n-6)/(n-3)	5.1 ^b	4.4 ^b	8.6 ^a	0.2	0.001
α -Tocopherol, $\mu\text{g/g}$	1.44 ^b	1.86 ^a	1.42 ^b	0.10	0.009
β -carotene, $\mu\text{g/g}$	0.024	0.036	0.013	0.007	0.24
<i>M. semimembranosus</i>					
C18:1n-9, %	28.6 ^a	21.6 ^b	29.7 ^a	1.5	0.003
C18:2n-6, %	14.8	21.7	16.4	1.9	0.06
C18:3n-3, %	2.23 ^b	4.06 ^a	1.01 ^c	0.23	0.001
(n-6)/(n-3)	5.4 ^b	4.8 ^b	8.6 ^a	0.2	0.001
α -Tocopherol, $\mu\text{g/g}$	1.94 ^{ab}	2.19 ^a	1.45 ^b	0.15	0.019
β -carotene, $\mu\text{g/g}$	0.024	0.021	0.007	0.005	0.06

^{a,b,c} values with different superscript are significantly different ($P < 0.05$)

Herb calves contained less oleic acid compared with Grass and Con calves, and close to four times more α -linolenic acid than Con calves with the Grass calves in between. Also linoleic acid was highest in herbs fed calves. The content of saturated fatty acids was 35-38 % of total fatty acids and did not differ between treatments. The content of β -carotene and α -tocopherol were also increased in the Herb calves compared with the Con calves, and with the Grass calves in between. These results correspond with results from French et al. [9], who found increased level of n-3 fatty acids when steers were fed pasture compared with basically concentrate and with Fraser et al. [10], who saw increased level of α -tocopherol in steers grazed on semi-natural rough grazing compared with improved permanent pasture. Thus there is a positive effect of the green feed and specifically the herbs on the content of vitamins and n-3 fatty acids, which from a human nutritional point of view is positive, and which could be used to promote beef raised on pasture and specifically if raised on more diverse herb-enriched pasture.

IV. CONCLUSION

The present experiment show that there are no drawbacks in finishing young bull calves for 6 weeks on purely grass or herb-based green feed in comparison with concentrate when it comes to meat and eating quality. The meat has similar color and sensory profile, but can be manipulated in a positive way by inclusion of herbs in the green feed as this increases the content of vitamins, linoleic and α -linolenic acid, as well as an improved (n-6)/(n-3) ratio.

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