CARCASS AND NUTRITIVE VALUE AS WELL AS PALATABILITY OF HOLSTEIN-FRIESIAN AND RED SPOTTED YOUNG BULLS DURING GROWTH

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Background:

In order to be able to elaborate purposeful breeding strategy knowledge of performance traits on carcass value and meat quality of the most widespread cattle breeds including German Red Spotted (RS) and German Holstein-Friesian (HF) is needed. Contribution of both breeds to beef production is considerable in spite of different directions of selection for meat and milk (KÖGEL et al., 1991).

Objectives:

The aim of this comparative study was to establish differences for composition and nutritive value of carcasses as well as meat quality traits during growth in young fattening bulls. Variation due to growth and feeding intensity has been suggested in previous studies (BOZÓ, 1993; RAMSEY, 1984 REICHARDT et al., 1997, SCHWARTZ et al., 1995, WILSON et al., 1981). The question, how both breeds could meet the requirements for production of high quality meat has to be studied (TEMISAN 1987; ENDER and AUGUSTINI, 1998) to elaborate well-established recommendations.

Methods:

Dual purpose German RS and dairy type German HF bull calves were used in this experiment within the framework of the TEMPUS Scientific Exchange Program. Animals were housed individually on semi-slatted floor and fed with rations consisting of grass haylage, maize silage and compound feed. Feeding regimen was assumed to provide nutrient supply well enough to meet the nutrient requirement for exploitation of maximum genetic ability for growth in both breeds. After lairage for 24 hrs animals (N=113) were slaughtered at one day and 6, 12, 18 and 24 months of age, and dissected according to standard procedure (DLG-Schnittführung, 1985) and using the method published by ENDER et al. (1987) by knife. Tissues were analysed for protein vs. ether extract content. In order to be able to establish potential differences samples were taken from M. longissimus dorsi (LD), M. semitendinosus (ST) and M. triceps brachii, caput longum (TB) and analysed for meat quality traits such as colour (MINOLTA Chromameter CR-200 for L*, a* and b* values), WHC (GROSSE et al., 1975), grilling, W-B.-shear force value and intramuscular fat. Data processing was made by GLM Procedure (SAS® Program Package, 1990) for breed, age and muscle effects and two-way interactions.

Results and Discussion:

Number of animals as well as performance recorded at slaughter is presented in Table 1. Significant age differences and breed x age interactions were established in almost all cases. Differences seem to extend during growth until 24 months. This phenomenon reveals higher growth capacity of RS as compared with HF. No breed differences for edible offal (liver, hart, lungs, tongue and spleen) were recorded even if relative values decreased during growth. Deposition of fat starts from 6 months the rate of which increases with chronological age. Tissue composition of the right half carcass dissected and protein as well as fat in cold carcass is presented in Table 2. Marked and age dependent superiority of RS for relative weight of meat and muscle meat range from 0.9-3.7 vs. 2.8-6.2 %, respectively. No breed differences were established for subcutaneous fat, whereas lower vales for intermuscular fat were recorded in RS than HF. Significant effects were established for all traits of tissue composition due to age and partly breed effects, and age x breed interaction. With advancing age and weight relative values of protein in the edible part of carcass show slight increases. Significant age and muscle effects were established for all meat quality traits (Table 3). Statistical breed effects were present only for b*-value and intramuscular fat content. This value for RS exceeded that of HF. Samples taken from RS tended to have deeper colour tone in comparison with HF mainly in ST and TB. Intramuscular fat content increases with advancing age and attained a peak of 4.5 % at 24 years of age for LD in HF and the lowest value of 1.7 % for ST in RS. As a rule, higher values were recorded in HF than RS. Inferiority of WHC was shown in ST, LD and especially TB with advancing age. Obvious age effects on lightness L* were recorded in all muscles with decrease in advanced age categories. Red a* and yellow b* values showed contradictory development during growth, whereas tenderness improved with advancing age. Age x breed interaction was established for intramuscular fat and breed x muscle one for tenderness and intramuscular fat. Quality traits influencing palatability such as WHC and W-B.-shear force value were affected by chronological age with muscle differences. For grilling inconsequent picture was shown for LD and ST. In case of tenderness improvement has been established with advancing age. Significant breed differences were found for intramuscular fat content as well with higher values in HF and lower ones in RS. Differences among muscle samples were also present (highest values for LD and TB, the lowest ones for ST). Intramuscular fat content increased steadily in all muscles with advancing age.

Conclusions:

In all carcass parameters marked age differences were registered with breed x genotype interactions. Findings reveal that, in comparison with HF the RS young bulls can be fattened up to relatively high final weights with improved dressing percentage. Differences seem to increase with advancing age. Evidence for superiority of RS over HF was present for the weight and percentage of internal fat in empty body and/or warm carcass weight. Percentages of meat, subcutaneous and intermuscular fat increased during growth, while that of bone and tendons decreased. Superiority of RS in comparison with HF for weight and percentage of meat and muscles as well as bone could be established with lower values of intermuscular fat. The weight of edible protein and fat in carcass is being increased during growth with expanding differences where superiority of RS over HF seemed to be obvious. On the contrary, no significant differences for the percentage of edible protein in cold carcass weight were present in this study. Higher protein content was recorded in the edible part of carcasses of RS young bulls in comparison with their HF counterparts. In general, samples taken from RS tended to have deeper colour tone in comparison with HF mainly for ST and TB. Quality traits influencing sensory and organoleptic properties of meat such as WHC and W-B.-shear force value were affected by chronological age with muscle differences. For grilling inconsequent picture are shown for LD and ST. Tenderness tended to improve with advancing age. Significant breed differences were found for intramuscular fat content, as well, with higher values in HF and lower ones in RS. Differences among muscle samples were also present. For both breeds intramuscular fat content increased steadily in all muscles with advancing age. In conclusion, marked age differences could be established among muscle samples for almost all meat quality traits according to breed effects in this study.

Pertinent literature:

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Table 1 Number of animals, and LSM and SE for performance recorded at slaughter

Traits	Breed	Age at slaughter, months				
		0	6	12	18	24
Number of animals	RS	4	10	12	14	15
	HF	6	9	13	15	15
Live weight, kg	RS	49.78±18.91	195.30±11.96	446.17±10.92	672.07±10.11	829.17±9.77
	HF	38.83±15.44	188.67±12.61	412.08±10.49	570.37± 9.77	712.60±9.77
Hot carcass weight, kg	RS	26.79±11.72	106.36± 7.41	256.52± 6.77	399.59± 6.26	502.87±6.05
	HF	22.42± 9.57	99.14± 7.81	221.85± 6.50	317.51± 6.05	406.74±6.05
Cold carcass weight, kg	RS	26.09±11.57	104.65± 7.32	251.92± 6.68	393.63± 6.19	495.90±5.98
	HF	21.84± 9.45	96.84± 7.72	218.11± 6.42	312.76± 5.98	402.11±5.98
Dressing percentage	RS	53.87± 0.76	54.45± 0.48	57.45± 0.44	59.44± 0.41	60.66±0.39
	HF	57.57± 0.62	52.53± 0.51	53.80± 0.42	55.67± 0.39	57.06±0.39
Edible offal/empty body weight, %	RS	6.63± 0.14	4.54± 0.09	3.80± 0.08	3.21± 0.08	3.04±0.07
	HF	6.30± 0.12	5.40± 0.09	4.43± 0.08	3.88± 0.07	3.57±0.07
Edible offal/hot carcass weight, %	RS	11.23± 0.27	7.36± 0.17	6.02± 0.16	4.92± 0.15	4.60±0.14
	HF	10.38± 0.22	8.98± 0.18	7.31± 0.15	6.25± 0.14	5.67±0.14
Perinephric fat/hot carcass weight, %	RS	1.18± 0.38	1.21± 0.24	2.07± 0.22	3.12± 0.20	3.96±0.19
	HF	1.29± 0.31	1.88± 0.25	3.53± 0.21	4.47± 0.19	5.83±0.19
Internal fat/empty body weight, %	RS	1.06± 0.50	1.69± 0.32	2.87± 0.29	4.24± 0.27	5.47±0.26
	HF	1.36± 0.41	2.75± 0.33	5.47± 0.28	6.80± 0.26	8.73±0.26
Internal fat/hot carcass weight, %	RS	1.79± 0.84	2.74± 0.53	4.54± 0.48	6.51± 0.45	8.30±0.43
	HF	2.24± 0.69	4.59± 0.56	9.03± 0.47	10.97± 0.43	13.89±0.43

Table 2 LSM and SE for tissue composition of the right half carcass dissected and protein as well as fat in cold carcass, %

Traits	Breed	Age at slaughter, months				
		0	6	12	18	24
Tissue composition of half carcass dissected, %						
Weight of right half carcass cold, kg	RS	13.07±5.77	52.44±3.65	126.04±3.33	197.60±3.08	247.23±2.98
	HF	11.06±4.71	48.41±3.84	108.70±3.20	156.60±2.98	201.12±2.98
Meat	RS	67.16±0.75	73.62±0.48	78.03±0.45	77.32±0.40	78.70±0.39
	HF	66.21±0.61	71.12±0.50	74.30±0.42	75.89±0.42	75.43±0.39
Muscle meat	RS	63.56±1.01	67.40±0.76	66.85±1.01	65.96±0.71	64.99±0.82
	HF	60.74±0.82	62.60±0.71	61.45±0.64	62.41±1.01	58.75±0.76
Subcutaneous fat	RS	1.06±0.47	1.70±0.29	3.04±0.28	4.64±0.25	5.60±0.24
	HF	0.58±0.38	2.05±0.31	3.29±0.26	4.46±0.26	6.15±0.24
Intermuscular fat	RS	3.60±0.79	5.64±0.60	10.43±0.79	10.39±0.56	13.03±0.64
	HF	5.46±0.64	7.98±0.56	12.16±0.50	11.95±0.79	16.04±0.60
Bone	RS	25.98±0.53	20.18±0.34	15.38±0.32	14.35±0.28	12.61±0.28
	HF	28.06±0.43	21.94±0.35	18.16±0.30	16.39±0.30	15.29±0.27
Tendons	RS	5.79±0.44	4.50±0.28	3.55±0.27	3.68±0.24	3.09±0.23
	HF	5.15±0.36	4.89±0.29	4.24±0.25	3.25±0.24	3.13±0.23
Protein and fat in cold carcass, %						
Protein	RS	13,20±0,38	14,96±0,24	15,49±0,23	15,19±0,20	14,87±0,20
	HF	12,98±0,31	14,18±0,26	14,64±0,21	14,41±0,21	13,75±0,20
Fat	RS	1,52±1,35	4,27±0,86	8,49±0,81	10,81±0,72	14,65±0,70
	HF	1,97±1,10	5,01±0,90	11,03±0,75	13,73±0,75	18,20±0,70

Table 3 LSM and SE for meat quality traits

Traits	Muscle	Breed	Age at slaughter, months				
			0	6	12	18	24
Lightness Minolta L^*	ST	RS	45.61±1.06	44.95±0.67	40.73±0.61	39.60±0.56	37.46±0.54
		HF	50.13±0.86	43.69±0.70	43.16±0.59	40.12±0.54	37.21±0.54
	LD	RS	44.43±3.11	35.11±1.97	40.16±1.80	34.56±1.66	31.94±1.61
		HF	45.53±2.54	35.21±2.08	35.63±1.73	34.57±1.61	32.45±1.61
	TB	RS	42.04±0.93	38.03±0.59	36.22±0.54	34.49±0.50	33.79±0.48
		HF	43.27±0.76	37.88±0.62	36.86±0.52	33.70±0.48	32.34±0.48
Red tone Minolta a^*	ST	RS	—	11.91±0.50	16.10±0.46	18.04±0.43	20.46±0.41
		HF	7.23±0.65	12.33±0.53	15.63±0.44	17.49±0.41	20.80±0.41
	LD	RS	—	10.32±0.51	13.15±0.47	16.17±0.43	18.49±0.42
		HF	7.93±0.66	11.63±0.54	13.75±0.45	15.60±0.42	18.18±0.42
	TB	RS	—	14.58±0.47	18.07±0.43	19.95±0.40	20.82±0.38
		HF	8.22±0.61	13.86±0.50	17.51±0.41	19.01±0.30	20.83±0.38
Yellow tone Minolta b^*	ST	RS	—	5.02±0.37	6.21±0.33	6.53±0.31	8.04±0.30
		HF	6.42±0.47	4.71±0.39	5.82±0.32	6.21±0.30	7.44±0.30
	LD	RS	—	1.21±0.35	2.15±0.32	3.34±0.29	4.51±0.28
		HF	4.44±0.45	1.36±0.37	2.61±0.30	3.05±0.28	4.19±0.28
	TB	RS	—	3.45±0.37	4.77±0.33	5.14±0.31	5.98±0.30
		HF	3.93±0.47	2.99±0.39	4.36±0.32	4.39±0.30	5.33±0.30
Water holding capacity	ST	RS	31.84±1.75	31.70±1.11	34.99±1.01	32.50±0.94	33.62±0.91
		HF	32.98±1.43	32.98±1.17	36.61±0.97	33.91±0.91	36.81±0.91
	LD	RS	32.33±1.72	25.13±1.09	28.59±1.00	29.29±0.92	30.99±0.89
		HF	29.76±1.41	27.88±1.15	30.36±0.96	29.33±0.89	31.98±0.89
	TB	RS	29.66±2.01	27.11±1.27	32.51±1.16	36.62±1.08	36.59±1.04
		HF	28.01±1.64	29.30±1.34	33.65±1.12	33.37±1.04	35.40±1.04
Grilling-loss	ST	RS	—	46.89±0.69	46.40±0.63	47.06±0.59	47.05±0.57
		HF	44.44±2.19	47.85±0.73	44.75±0.61	46.53±0.57	47.50±0.59
	LD	RS	—	46.52±0.81	44.40±0.66	44.09±0.61	44.51±0.59
		HF	36.57±1.33	46.65±0.81	42.67±0.64	44.17±0.59	44.88±0.59
	TB	RS	—	45.31±0.67	44.76±0.58	45.18±0.53	45.67±0.52
		HF	42.14±2.00	45.09±0.71	44.59±0.55	45.46±0.52	45.91±0.52
WB-shear force value	ST	RS	—	15.02±0.62	13.79±0.56	13.82±0.52	13.65±0.50
		HF	9.03±1.13	14.17±0.65	12.79±0.54	12.82±0.50	13.28±0.52
	LD	RS	—	15.83±0.96	15.36±0.88	13.88±0.81	12.50±0.79
		HF	8.80±2.15	13.86±1.01	14.12±0.85	14.10±0.79	9.95±0.79
	TB	RS	—	11.04±0.73	8.23±0.66	6.99±0.62	7.08±0.59
		HF	7.40±1.03	10.12±0.77	10.48±0.64	10.49±0.60	8.89±0.59
Intramuscular fat	ST	RS	0.23±0.35	0.35±0.22	1.34±0.20	0.92±0.19	1.69±0.18
		HF	0.39±0.29	0.60±0.24	1.34±0.20	1.40±0.18	2.42±0.18
	LD	RS	0.28±0.47	0.23±0.30	1.20±0.27	1.34±0.25	2.78±0.24
		HF	0.37±0.39	0.64±0.31	1.85±0.26	2.74±0.24	4.53±0.24
	TB	RS	0.28±0.39	0.39±0.25	1.36±0.22	1.37±0.21	2.94±0.20
		HF	0.35±0.32	0.55±0.26	1.22±0.22	1.83±0.22	3.46±0.20