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BREED DIFFERENCES IN CARCASS AND MEAT PROPERTIES

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Please refer to Folio 34A.

INTRODUCTION

In Europe the major part of beef is produced with dual purpose or specialized dairy breeds, while in America the major part of beef is produced with specialized beef breeds (Eurostat 5A, 1989). In Slovenia the major part of beef is produced with dual purpose Simmental breed, which presents 60% of total number of cattle. Dual purpose Brown breed (crossbred with Brown Swiss) represents 30% and the specialized dairy Black/White breed 8% of the total number. Crossbreeds with specialized beef breeds present only a few percents. The introduction of specialized beef breeds is required because of the surplus of milk and deficit of beef in recent years. The negative correlation between milk production and carcass quality is well known (Zagozen and Locniskar, 1987), and therefore meat production with beef breeds and their crossbreeds becomes more important. The European market is well provided with beef and for this reason our efforts are directed to the improvement of beef quality, because Slovenia is traditional exporter on Western European market. Improved carcass and beef quality is not satisfying valued yet, but it is expected in near future. Qualitative beef properties which will influence market value of beef are subject of our research.

MATERIALS AND METHODS

Carcass and meat properties were analyzed from the progeny testing results of Simmental and Brown bulls. Small groups of Black/White bulls were included for comparison. Simmental (n=70), Brown (n=64) and Black/White (n=20) bulls were slaughtered at the end of testing without previous fasting immediately after arrival at the slaughterhouse. Carcasses were weighed one hour after slaughter and subjectively valued with regard to fleshiness, fattiness and meat quality for a total score of 50 points. Carcass length and depth were measured. Conformation index (Ci) was calculated with the geometric formula:

$$C_i = \frac{\text{carcass weight}}{\text{carcass length} * \text{carcass depth}}$$

Conformation index presents average carcass thickness as objective indicator of carcass quality. Cross-section area of longissimus dorsi muscle (MLD) was measured between 7th and 8th rib. Probes for muscle fibre analysis were sampled on the same section. Muscle fibre analysis was done with the method described by Hegarty and Naude (1970). Right carcass side was dissected with the method of rough tissue separation into lean, fat, bones and tendons. Probes for sensory and chemical analyses were sampled between 7th and 11th rib. Shear force of the cooked meat was measured instrumentally (Instron) on the same probes. Data were analyzed with SAS programme with GLM procedure. The live weight was included as covariable in carcass and muscle fibre traits, and percentage of intramuscular fat in physical-chemical and sensory meat properties.

RESULTS AND DISCUSSION

Table 1 shows subjective and objective carcass properties of all breeds, corrected to equal live weight of bulls. There were no differences between breeds in carcass weight, but dressing percentage was significantly lower for the Black/White breed ($P<0.05$). The Black/White breed deviated negatively even more in subjective valuation of carcasses, while the differences of conformation index were highly significant between all breeds ($P<0.01$). The Black/White breed deviated negatively in carcass composition, as an objective criterion of carcass quality, from the other two breeds while the Simmental breed had lower percentage of bones and tendons than the Brown breed. The same relation between breeds was shown also in percentage of meat on live weight and in percentage of more valuable parts of meat. Similar differences in carcass quality between these breeds are also mentioned by other authors (Cepin *et al.*, 1987, Rosenberger *et al.*, 1987, Averdunk *et al.*, 1990).

Table 2 shows cross-section areas of MLD and muscle fibre analysis. Cross-section areas amounted to 52.2cm^2 for the Simmental breed, 48.4cm^2 for the Brown breed and 44.9cm^2 for the Black/White breed. The differences between Simmental and other two breeds were highly significant ($P<0.01$). Average diameter of muscle fibres amounted to 66m for all breeds and the total number of muscle fibres on MLD cross-section was in equal ratio as MLD cross-section area. Similar results are mentioned by Osterc (1974) and Skorjanc (1991).

Table 3 shows the physical-chemical and sensory meat properties, corrected to equal percentage of intramuscular fat. pH value of meat after 24-hours cooling amounted on average to 5.65 and there were no significant differences between breeds. Thaw losses of meat probes for sensory analyses were the highest for the Simmental breed (6.4%) and the lowest at Brown breed (3.8%) and the differences were highly significant ($P<0.01$). Cooking losses amounted on average to 22.5% and the differences between breeds were not significant. Common losses for the Simmental breed amounted to 27.6% and they were significantly higher than others (27.7% and 25.6%). Average shear force of meat (longitudinal and transversal) was the highest for the Brown breed (170.3N) and the lowest for the Black/White breed (146.6N), and the difference was significant ($P<0.05$). This result was also confirmed by sensory analysis (Panel test), which showed the highest tenderness of meat for the Black/White breed. Flavour and juiciness were also valued as best for the Black/White breed. This result is connected with higher percentage of fat in carcasses for the Black/White breed. Chemical analyses showed Brown breed containing the highest percentage of water (75.31%), Black/White breed containing the highest percentage of ash and the Simmental breed containing the highest percentage of protein.

Table 4 shows phenotypical correlation coefficients between different meat and carcass properties. Carcass properties were reciprocally more connected than meat properties. Variability was greater and influences less studied at meat properties. Similar correlations are mentioned by other authors (Rosenberger *et al.*, 1987, Temisan and Augustini, 1987).

CONCLUSIONS

On the basis of research results it can be obviously concluded that differences between Simmental, Brown and Black/White breeds are significant. Simmental presents the best and Black/White the worst breed in carcass properties, while differences between breeds in meat properties are less significant and Black/White breed is better in some cases.

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Table 1. Carcass characteristics for the three breeds.

	SIMMENTAL(1) n=70 LSQ ±SE	BROWN(2) n=64 LSQ ±SE	BLACK/WHITE(3) n=20 LSQ ±SE
Slaughter weight, kg	340.5 ±1.30	336.5 ±1.43	331.8 ±2.62
Dressing per cent (%)	59.2 ±0.23	58.6 ±0.25	57.7 ±0.45
Sub.car valuation[1]	44.3 ±0.36	43.3 ±0.40	36.5 ±0.72
Conformation index	64.5 ±0.50	58.7 ±0.55	54.7 ±1.02
Lean, %	71.5 ±0.25	71.3 ±0.28	67.8 ±0.50
Fat, %	10.9 ±0.28	10.3 ±0.30	12.3 ±0.56
Bone, %	15.8 ±0.14	16.8 ±0.15	18.1 ±0.28
Tendon, %	1.8 ±0.03	1.6 ±0.04	1.8 ±0.06
Lean/live weight	41.0 ±0.24	40.5 ±0.26	38.0 ±0.48
Valuable cuts[2], %	53.5 ±0.20	52.8 ±0.22	51.6 ±0.40
Lean/bone	4.6 ±0.04	4.3 ±0.04	3.8 ±0.08
Lean/fat	6.9 ±0.22	7.4 ±0.24	6.0 ±0.44

Table 1 (cont). Carcass characteristics for the three breeds.

	P-values between breeds 1-2	1-3	2-3
Slaughter weight, kg	0.042	0.004	0.119
Dressing per cent (%)	0.043	0.002	0.093
Sub.car valuation[1]	0.065	0.000	0.000
Conformation index	0.000	0.000	0.001
Lean, %	0.580	0.000	0.000
Fat, %	0.163	0.024	0.002
Bone, %	0.000	0.000	0.000
Tendon, %	0.001	0.557	0.005
Lean/live weight	0.158	0.000	0.000
Valuable cuts[2], %	0.034	0.000	0.001
Lean/bone	0.000	0.000	0.000
Lean/fat	0.095	0.066	0.004

[1] Subjective carcass valuation is sum of fleshiness, fat covering and meat quality.
[2] Valuable cuts represent sum of shoulder, back, loin, fillet and hind limb.

Table 2. Muscle fibre characteristics for the three breeds.

	SIMMENTAL(1) n=70 LSQ ±SE	BROWN(2) n=64 LSQ ±SE	BLACK/WHITE(3) n=20 LSQ ±SE
MLD area, cm^2	52.2 ±0.87	48.4 ±0.90	44.9 ±1.86
m.fibre diameter, μm	65.7 ±0.65	65.7 ±0.68	66.6 ±1.40
m.fibre number/mm^2	320 ±6	307 ±6	284 ±13
m.fibre n. in MLD	1666 ±42	1489 ±44	1274 ±90

Table 2(cont). Muscle fibre characteristics for the three breeds.

	P-values between breeds		
	1-2	1-3	2-3
MLD area, cm^2	0.003	0.000	0.090
m.fibre diameter, μm	0.995	0.560	0.561
m.fibre number/mm^2	0.180	0.018	0.122
m.fibre n. in MLD	0.004	0.000	0.034

Table 3. Meat properties for the three breeds.

	SIMMENTAL(1) n=70 LSQ ±SE	BROWN(2) n=64 LSQ ±SE	BLACK/WHITE(3) n=20 LSQ ±SE
Thaw losses, %	6.4 ±0.25	3.8 ±0.28	4.8 ±0.58
Roasted losses, %	22.6 ±0.33	22.8 ±0.37	22.1 ±0.75
∑ losses, %	27.7 ±0.38	25.3 ±0.86	25.3 ±0.86
Shear forces, N:			
transverse	222.0 ±6.50	217.8 ±7.23	180.3 ±14.85
longitudinal	110.2 ±2.95	122.8 ±3.28	112.1 ±6.74
trans.+long.	166.1 ±4.19	170.3 ±4.66	146.6 ±9.58
Tenderness[1]	4.8 ±0.11	4.39 ±0.12	5.10 ±0.25
Juiciness[1]	5.15 ±0.04	5.43 ±0.05	5.48 ±0.10
Flavour[1]	5.21 ±0.05	5.39 ±0.05	5.85 ±0.10
Water, %	74.76 ±0.08	75.31 ±0.09	74.67 ±0.19
Ash, %	0.94 ±0.02	0.94 ±0.03	1.08 ±0.05
Protein, %	21.93 ±0.08	21.39 ±0.09	21.89 ±0.18
pH	5.66 ±0.02	5.67 ±0.02	5.63 ±0.05

Table 3 (cont). Meat properties for the three breeds.

	P-values between breeds 1-2	1-3	2-3
Thaw losses, %	0.000	0.016	0.097
Roasted losses, %	0.779	0.530	0.442
∑ losses, %	0.001	0.014	0.622
Shear forces, N:			
transverse	0.668	0.010	0.027
longitudinal	0.005	0.794	0.161
trans.+long.	0.512	0.062	0.030
Tenderness[1]	0.515	0.002	0.011
Juiciness[1]	0.000	0.004	0.714
Flavour[1]	0.016	0.000	0.000
Water, %	0.000	0.639	0.003
Ash, %	0.962	0.020	0.024
Protein, %	0.000	0.000	0.015
pH	0.951	0.525	0.517