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INFLUENCE OF CROSSING THE SIMMENTAL BREED WITH SOME FLESHY-TYPE BREEDS ON THE CARCASS VALUE AND MEAT QUALITY

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INTRODUCTION

It is well known that the crossing of milk cows with bulls of flesh-type or combined breeds with pronounced meat production represents a useful and practical way of improving the carcass quality of slaughtered animals.

In Vojvodina, a province in Yugoslavia, the majority of cattle for fattening originate from the domesticated Simmental race of combined properties. In the 1960s, the crossing process was started using mainly Holstein-Friesian and, to a lesser extent, the Jersey breed, with the aim of improving milk production. However, that program had positive and negative results. The number of calves declined and the fattening characteristics worsened, especially of carcass quality.

For that reason, we began a program crossing cows of combined breeds (Simmental) with bulls of fleshy-type (Hereford, Limousine and Charolais) to determine the best crossing combinations regarding the resulting fattening characteristics and meat quality. Initial results of this study is presented in this paper.

MATERIAL AND METHODS

The crossing was performed for the production of steers and heifers for the planned experiment. The following genotypes were used:
cows of combined types: Simmental breed (SM); and
bulls of fleshy-type: Hereford (HF), Limousine (LM) and Charolais (CH).

The steers in all experimental groups were kept under the same conditions from birth. During the fattening period, they were fed a combination of concentrated food and hay. Steers at the age of 13 to 14 months were transferred by truck to the stockyard and slaughtered the following day in the usual way. After the weighing of warm carcasses, they were cooled again in the usual manner.

Next morning, 24 hours post-mortem, the thoracic part of the *m.longissimus dorsi* from the left half of the carcass (four carcasses from each experimental group) was cut off between the 4^{th} and 6^{th} vertebrae (approximately 400g) to be used for meat quality examination. pH was measured by potentiometry using the portable pH-meter made by Gronert, type TM 5. The water holding capacity (WHC) and plasticity were determined by compression according to Grau and Hamm (1953). The fibre diameter was determined on native preparations obtained after homogenization of samples with 0.9% NaCl with Ultra Turax (Janke Kunkel) at 5000 min^{-1} for two to three seconds. The chemical composition (e.g., the content of water, proteins, fat and ash) was determined by usual methods (AOAC, 1980). The content of hydroxyproline was determined by spectrophotometrical method according to Stegemann and modified by Prändl *et al.* (1967). The obtained value, multiplied by a factor of 7.1, gives the content of connective tissue protein.

The colour characteristics were determined on tristimulus photocolorimeter MOM Colour 100. According to the CIE system, the values of colour brightness (reflectance), dominant wavelength and colour purity were stated (Sears, 1963; Pribis and Rede, 1982). The total pigments (TP) were determined by Möhler's modification of the Hornsey (1958) method. A five-member panel evaluated colour and marbling (as the amount and distribution of fatty tissue) of fresh muscles according to a point system for colour (1=very light-red to 7=black-red) and for marbling (1=without marbling to 10=abundant).

The cooking loss was calculated from the difference of sample mass before and after cooking in polyethylene bags dipped in a water bath at 90°C for one hour. The tenderness of samples was determined using the Warner-Bratzler apparatus, measuring the force (in kilograms) of shearing a cylinder (12.7mm) cut from the cooking sample. Eight individual measurements were performed on every sample. The softness and juiciness of heat-treated samples were evaluated sensory by a five-member panel according to a point system (1=extremely coarse and dry to 9=extremely soft and juicy).

The arithmetic mean value and standard deviation were then calculated and the significance of differences of mean values of the examined meat and muscle characteristics of steers of pure breeds and crosses (SM/SMxHF; SM/SMxLM; SM/SMxCH) were tested ("t-test") (Joslmovic, 1971).

RESULTS AND DISCUSSION

The obtained results are presented in five tables.

The data given in Table 1 shows that the biggest mass of warm carcass and dressing percentage was found in the crossbred SMxLM, significantly higher than in the SM breed ($P<0.05$). The smallest carcass mass was found in crossbreeds SMxHF while the lowest dressing percentage was from the SMxCH crosses. The fibre diameter of *m.longissimus dorsi* of the three crossbreed groups was bigger than of steers of the SM breed, but the differences were not significant.

As it is obvious from the data presented in Table 2, the highest protein content (22.01%) was found in the *m.longissimus dorsi* of the SMxHf breed, and it is significantly higher than that of the SM breed ($P<0.05$). The muscle protein content of the SMxCH breed were the lowest and were even lower than that for the SM breed.

No bigger differences were estimated for the water content. However, values for fat content were pronouncedly different. These differences are not statistically significant compared to values for muscles of the SM breed but between crossbreeds they are significant (this significance is not presented in Table 2). The lowest fat content (1.60%) was found in the muscle of the SMxHF cross and the highest (3.93%) was found in the SMxCH cross.

Comparing the connective tissue protein content, there were no significant differences found between the examined groups ($P>0.05$).

The ph_{24} value is the lowest in the SMxHF cross. It is somewhat higher and equal in crossbreeds SMxLM and SMxCH and the highest value is found in the SM breed. However, the differences are not significant ($P>0.05$). It can further be seen that the water holding capacity of muscles of crossbreeds is higher than those of the SM breed. The highest values were found in the SMxLM cross (60.03%) and the cooking loss during heat treatment was also the lowest in this cross (39.44%). It was also the most tender (9.41) as determined by the WB apparatus while the muscle of the SM breed was the toughest (10.16kg) although the difference was not significant ($P>0.05$).

The measuring of colour characteristics of m.longissimus dorsi, determination of TP content (Table 4) and sensory colour evaluation (Table 5) resulted in the findings that the muscle of the SMxHF cross are the darkest and the muscle of the SMxCH are the lightest. The muscle colour of the SM breed, as well as for the SMxLM cross, fall between the other two groups.

The difference of mean reflectance, colour purity and sensory value of colour between the muscles of the SM breed and the SMxHF cross is statistically significant ($P<0.05$).

The marbling is the least pronounced in muscle of the SMxHF cross (2.5 points) and very pronounced in the SMxCH cross (5.5 points). However, muscle of the SMxLM cross are the toughest and are significantly drier (P<0.01) than those of the SM breed, which are also rather tender (e.g., the ranking order shows that they are next to the SMxLM cross in tenderness and are the juiciness).

As mentioned earlier, the crossing of SM breed cows of combined qualities with bulls of fleshy-type breeds resulted in increased meat mass on carcasses in the case of cross SMxLM and SMxCH, as well as dressing percentage in the SMxLM cross, while obtained meat mass of carcasses from the SMxHF cross was lower than in the SM breed although the dressing percentage was slightly higher. This finding supports the opinion that the purposive crossing can influence the carcass quality and meat yield (Buchter, 1985; Harrington, 1986; Augutini and Temisan, 1989).

The obtained results led us to believe that the best results considering the slaughter quality were obtained from cross-breeding with the LM breed. The quality of SMxCH crosses was somewhat lower and the SMxHF cross did not result in improved carcass quality.

The HF breed is not convenient for crossing with domesticated Simmental in our region, e.g., regarding the fattening performance, as well as the carcass quality, the HF breed is significantly less valuable than the domesticated Simmental breed, as stated earlier by Cobic *et al.* (1990).

The analysis of the presented meat characteristics also shows that the meat obtained from the SMxLM cross is of the best quality. The water holding capacity is the best; the cooking loss is the smallest; and by sensory analysis and instrumentally, it was found that this meat is the softest and very juicy. It is interesting to mention that the meat of the SMxCH cross was of poorer quality, namely the cooking loss was higher and it was tougher in spite of the opinion that the higher fat content (marbling) contributes to better flavour and tenderness of meat (Savell and Cross, 1986; Augustini and Temisan, 1989). However, according to the mentioned authors, this finding could be explained by the different physiological maturity of the investigated animals.

CONCLUSION

At the breeding conditions of our region, with the aim of improving the carcass quality as well as of the meat quality, the most advantageous for the crossing of the domesticated Simmental breed of combined properties proved to be the Limousine breed. The Charolais breed is somewhat less advantageous while the Hereford breed, when considering the quality characteristics, is even worse than the domesticated Simmental breed.

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Table 1. Some characteristics of carcass and muscles of Simmental breed (SM) and crosses with Hereford (SMxHF), Limousine (SMxLM) and Charolais (SMxCH).

Characteristic		SM	SMxHF	SMxLM	SMxCH
Carcass Mass (kg)	X	283.3	272.6	323.8*	291.5
	S	31.19	31.06	6.13	14.73
Dressing Percentage	X	55.89	56.85	59.82**	55.76
	S	2.39	1.69	1.75	0.75
Fibre Diameter (μm)	X	27.24	32.35	30.63	28.29
	S	4.33	2.95	4.72	1.97

* Differences are statistically significant with 95% probability ($P<0.05$).

** Differences are statistically significant with 99% probability ($P<0.01$).

Table 2. Chemical composition of m.longissimus dorsi of steers of Simmental breed (SM) and cross with Hereford (SMxHF), Limousine (SMxLM) and Charolais (SMxCH).

Characteristic	SM	SMxHF	SMxLM	SMxCH
Proteins percent	19.68	22.01*	20.65	18.91
	0.72	1.34	1.36	0.89
Water percent	78.86	75.47	76.15	75.92
	1.16	0.38	0.38	2.34
Fat percent	2.30	1.60	1.99	3.93
	1.80	0.89	1.47	2.18
Mineral matters(%)	1.16	0.95*	1.18	1.01*
	0.01	0.01	0.13	0.01
Connective tissue proteins (%)	0.66	0.69	0.75	0.70
	0.17	0.11	0.01	0.29

* Differences are statistically significant with 95% probability ($P<0.05$).

Table 3. Some technological characteristics of m.longissimus dorsi steers of Simmental breed (SM) and cross with Hereford (SMxHF), Limousine (SMxLM) and Charolais (SMxCH).

Characteristic	SM	SMxHF	SMxLM	SMxCH
pH_{24} X	5.84	5.67	5.76	5.76
S	0.11	0.01	0.21	0.21
Water holding X	52.84	57.13	60.03	60.00
% S	4.10	2.17	8.30	3.28
Plasticity X (cm^2)	3.39	3.96	3.49	3.28
S	0.42	0.49	0.16	0.01
Cooking loss X				
S	2.31	2.73	2.35	1.28
WB (kg)	10.16	10.14	9.41	9.52
	2.63	1.93	2.20	2.38

Table 4. Colour characteristics of m.longissimus dorsi steers of Simmental breed (SM) and cross with Hereford (SMxHF), Limousine (SMxLM) and Charolais (SMxCH).

Characteristic	SM	SMxHF	SMxLM	SMxCH
Mean Reflectance X	12.07	8.93*	11.21	12.24
(%) S	1.88	1.01	2.80	1.69
Dominant X wavelength	598	615	603	598
(nm) S	0.00	0.00	8.35	0.00
Colour Purity X	18.69	17.06*	18.69	18.79
(%) S	0.00	1.37	2.22	0.12
TP X	131.75	178.5	120.7	121.55
(μm) S	33.70	22.47	17.23	27.81

Table 5. Sensory values of some characteristics of fresh and heat-treated m.longissimus dorsi steers of Simmental breed (SM) and cross with Hereford (SMxHF), Limousine (SMxLM) and Charolais (SMxCH).

Characteristic	SM	SMxHF	SMxLM	SMxCH
Colour X	1.50	3.25*	2.00	1.75
S	0.71	0.96	1.35	0.50
Marbling X	4.25	2.50	2.75	5.50
S	1.50	1.00	0.50	0.52
Softness X	5.75	4.63	6.75	5.00
S	1.89	0.69	0.50	1.82
Juiciness X	7.25	4.63**	7.13	6.25
S	0.96	0.69	0.85	1.50

* Differences are statistically significant with 95% probability ($P<0.05$).
** Differences are statistically significant with 99% probability ($P<0.01$).