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

PETROVIC LJILJANA[1], M. PETROVIC[1], R. REDE[1], D. MEDIC[2] and T. STAMENKOVIC[3]

1 Faculty of Technology, University of Novi Sad, 21000 Novi Sad, Yugoslavia
2 Research Institute for Reproduction and Artificial Insemination, 21000 Novi Sad, Yugoslavia
3 Yugoslav Institute of Meat Technology, 11000 Beograd, Yugoslavia

INTRODUCTION

It is well known that the crossing of milky cows with bulls of fleshy 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 originates from the domesticated Simmental race, of combined properties. In the sixtieth, the crossing process started, mainly with the Holstein-Friesian and less with the Jersey breed, with the aim of improving the milk-production. However, that resulted both in desired positive and some negative consequences. In the first place, the number of calves decreased, the fattening characteristics became worse, especially of carcass quality.
For that reason began the investigations of crossing of cows of combined breed (Simmental) with bulls - of fleshy type (Hereford, Limousine, Charolais) to find the most convenient crossing combinations for our conditions regarding the fattening characteristics and meat quality. A part of these investigations is presented in this work.

MATERIAL AND METHODS

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

From the birth till the intensive fattening, the steers of all experimental groups were kept at the same condition. During the fattening period they were attached, fed with the combination of concentrated food and hay. Steers at the age of 13 to 14 months, were transferred by trucks the day before to the stockyard and then slaughtered in the usual way. After the weighing of warm carcasses, they were cooled in the usual way.

Next morning, 24 hours post-mortem, from the left halves (four carcasses from every experimental group) the thoracic part of *m.longissimus dorsi* was cut off between the 4^{th} and 6^{th} vertebra (approximately 400g) and was used for the 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 method 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, modified by Prändl *et al.* (1967). The obtained value multiplied with the factor 7.1 gives the content of connective tissue protein.

The colour characteristics were determined on trisimulus photocolorimeter MOM Color 100. According to the CIE system the values of colour brightness (mean 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 Hornsey method (1958).

A five-member panel evaluated the colour and marbling (as the amount of distribution of fatty tissue) of fresh muscles according to the point system for the colour from 1 (very light-red) to 7 (black-red) and for marbling from 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 water bath at 90°C for one hour.

The tenderness of samples was determined using the Warner-Bratzler apparatus, measuring the force (kg) of shearing a cylinder (ø 12.7mm) which was cut out from the cooked sample. Eight individual measurements were performed for every sample.

The softness and juiciness of heat treated samples were sensory evaluated by a five-member panel, according to the point system from 1 (extremely coarse and dry) to 9 (extremely soft and juicy). The arithmetic mean value and standard deviation were 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 (test) (Josimović, 1971).

RESULTS AND DISCUSSION

The obtained results are presented in five tables.

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

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

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

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

The pH24 value is the lowest in muscles of SMxHF, it is somewhat higher and equal in crossbreeds SMxLM and SMxCH and the highest value was found in muscles of SM breed. However, the differences are not significant ($P<0.05$). Further, it can be seen that the water holding capacity of muscles of crossbreeds is higher than of muscles of SM breeds.

The highest values were found in muscles of SMxLM crossbreeds (60.03%) and the cooking loss during heat treatment was also the lowest in these muscles (39.44%). In the same time, the heat-treated muscles of the same group are the most tender (9.41) as determined by the WB apparatus while the muscles of SM breed were the toughest (10.16kg) though the differences are not significant ($P<0.05$).

The measuring of colour characteristics of *m.longissimus dorsi*, determining of TP content (Table 4) and sensory colour evaluation (Table 5) resulted in the finding that the muscles of SMxHF crossbreeds are the darkest and the muscles of SMxCH crossbreeds are the lightest. The colour of muscles of SM breed, as well as of SMxLM crossbreed, is according to the majority of investigated characteristics between the values of these two groups of crossbreeds.

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

The marbling is the least pronounced in muscles of SMxHF crossbreeds (2.5 points) and very pronounced in SMxCH crossbreeds (5.5 points). However, muscles of SMxLM crossbreeds are the softest (6.75 points) and very juicy (7.13 points). The muscles of SmxHF crossbreeds are the toughest and significantly dryer ($P<0.01$) than the ones of SM breeds, which are also rather tender, e.g., the ranking order shows that they are next to muscles of SMxLM crossbreeds and the juiciness was the greatest.

As mentioned earlier, the crossing of cows of SM breed, of combined properties, with bulls of fleshy type, resulted in increase of meat mass in carcasses in case of crossbreeds SMxLM and SMxCH as well as of dressing percentage in SMxLM crossbreeds while the obtained meat mass of carcasses in crossbreeds SMxHF was lower than in SM breeds, and the dressing percentage slightly higher. This finding supports the opinion that the purposive crossing can influence the carcass quality and the meat yield (Butcher, 1985; Harrington, 1986; Augustini and Temsian, 1989).

The obtained results led us to believe that at the breeding conditions applied in this work, which are also typical for our region, the best results considering the slaughter-quality were obtained for crossbreeds with LM breed, the quality of SMxCH crossbreeds was somewhat lower, while the crossing with HF breed didn't result in improved carcass quality.

HF breed is not convenient for crossing with domesticated Simmental (DS) breed at the fattening conditions in our regions, e.g., regarding the fattening performance, as well as the carcass quality, the HF breeds are significantly less valuable than the domesticated simental breed, as stated earlier by Cobić *et al.* (1990).

The analysis of the presented meat characteristics also shows that the meat obtained from SMxLM crossbreed is of 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 in the same time very juicy. It is interesting to mention that the meat of SMxCH crossbreeds 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 the 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.

The meat of SMxHF crossbreeds is also of worst quality; it is rather dark and after the heat treatment it was rather tough and insufficiently juicy.

CONCLUSION

At the breeding conditions in our regions, with the aim of improving the carcass quality, as well as of the meat quality, the most advantageous for the crossing with the domesticated Simmental breed of combined properties proved to be the Limousine breed. Charolais breed is somewhat less advantageous, while the hereford breed, regarding the quality characteristics, is even worse than the domesticated simental breed.

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

		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	2.36	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 (SM) and crossbreeds with Hereford (SMxHF), Limousine (SMxLM) and Charolais (SMxCH).

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

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

		SM	SMxHR	SMxLM	SMxCH
pH_{24}	x S	5.84 0.11	5.67 0.01	5.76 0.21	5.76 0.21
Water holding capacity, %	x S	52.84 4.10	57.13 2.17	60.03 8.30	60.00 5.11
Plasticity, cm^2	x S	3.39 0.42	3.96 0.49	3.49 0.49	3.28 0.01
Cooking loss, %	x S	40.42 2.31	40.70 2.73	39.44 2.35	41.17 1.28
WB, kg	x S	10.16 2.63	10.14 1.93	9.41 2.20	9.52 2.38

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

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

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

		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