PERSPECTIVES AND RESULTS OF COMMERCIAL CROSSING IN DAIRY HERDS WITH BEEF SIRES ON LARGE SCALE OPERATIONS

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SUMMARY: One of the possible ways to increase beef production in dairy herds is commercial crossing with beef sires. The aim of this study was to learn the effects of this procedure on performance, carcass value and beef quality in Holstein-Friesian /HF/ and Holstein-Friesian x Limousin /HFxL/ cattle.

In experiment 1 HF /n=8/ and HFxL /n=8/ young fattening bulls were slaughtered at 503 vs. 499 days of age and in 516 vs 521 kg final weight, respectively. At slaughter samples were taken from selected by-products /paunch, heart/ and at dissection from three muscles /LD, PS, GM/. We determined the chemical composition including moisture, intramuscular fat and protein content of samples taken. Even if no essential change in terms of either traits mentioned above could be established between purebreds and crossbreds, differences among by-products and muscles proved to be obvious. In comparison to purebred HF young bulls in the half carcasses of HFxL crossbreds higher amount of kidney fat /5.3 vs. 6.3 kg/, larger muscle eye area /87.6 vs. 101.0 cm^2/, higher dressing percentage /57.4 vs. 59.4 per cent/ and lower bone ratio /19.5 vs. 16.8/ was found.

In experiment 2 figures of standard carcass classification were compared the base of which are the following criteria: final weight, dressing percentage and ratio of kidney fat. Data of 672 individuals were evaluated. Between purebreds and crossbreds marked differences could be established in terms of the performance /ADWG/, dressing percentage, ratio of kidney fat and distribution of carcasses among 5 classification categories in favour of HFxL crossbreds.

In conclusion superiority of HFxL crossbreds over purebred HF could be figured out. Commercial crossing of low milk producers in HF herds with L sires seems to be justified, the extent of the procedure, however, might be limited by factors such as reproductive status of the dairy herd and/or replacement needed.

INTRODUCTION: In most countries with developed cattle production the necessary amount of milk can easily be produced by a reduced cow population to meet the demand of the market.

Even more level of milk production caused governments to introduce quota systems in surplus areas. The consequence was depression of young stock available for meat production. The disharmony between the reduction of cow population and requirements for meat of high quality can hardly be cleared up with fattening of animals up to high final weights as it was the case at recent times, let alone perfectly. For this reason endeavours have to be made in order to be able to produce beef of high quality needed. Both scientists and breeders seem to share the view that the output of slaughter cattle can be improved by various measures, first of all by commercial crossing of low milk producing female stock with beef sires. Thus, prevailing conditions in this country fostered considerations of applying commercial crossing as one possible way in Holstein-Friesian herds with Limousin sires as paternal breed to achieve the goals mentioned above.
Taking into account the considerations mentioned above the aim of this study was to assess the advantages and disadvantages of the procedure and to figure out its influence on the performance and beef production traits in terms of growth rate, carcass composition, dressing percentage and chemical composition of selected tissue samples taken by slaughter and dissection as well as distribution of carcasses across classification categories.

MATERIALS AND METHODS: In 1985/86 two separate studies were carried out at the cattle fattening unit of the co-op farm "Vörös Csillag", Füzesgyarmat, Hungary. Animals were slaughtered at the Slaughter House and Meat Processing Plant, Gyula, Hungary. In experiment 1 a pilot study was conducted under controlled conditions with growing-finishing bulls, whereas in experiment 2 a field study was made on both male and female individuals covering performance data as well as figures of carcass evaluation recorded on the farm and the abattoir, respectively.

Dairy herd of the co-op farm consists mainly of straightbred Holstein-Friesian cows. One part of the herd was used for crossbreeding with Limousin sires. Male and female progeny born to Holstein-Friesian and from Limousin sires as well as their straightbred counterparts were involved in this study for comparison.

Experiment 1. Young fattening bulls were raised in two groups up to 520 kg live weight on maize silage based diets with moderate compound feed supplementation. For slaughter 8 animals were randomly selected from each group. They were transported to the abattoir on lorry and slaughtered immediately after arraival. Following bleeding skin, internal organs and kidney fat were removed and weighted. Carcasses were split and chilled overnight until dissection. Half carcasses were cut into joints and the right half carcass was dissected according to standard procedure, where tissues were separated into meat, fat and bone. At slaughter and dissection tissue samples were taken from the heart, rumen and selected muscles /M. longissimus dorsi - LD, M. psoas major - PS, M. gluteus medius - GM/. Moisture-, protein-

and intramuscular fat content of samples were determined according to standard procedures listed in MSZ 6830/3-77/.

Experiment 2. Figures of carcass classification of purebred and crossbred progeny born to Holstein-Friesian cows and from Holstein-Friesian vs. Limousin sires have been recorded for 5 years at the "Vörös Csillag" co-op farm, Füzesgyarmat, Hungary. Carcass classification was made at the abattoir according to the rules desvribed in the Hungarian Standard MSZ 6915/1979. /The principles taken into account in the scheme include final weight of the animals, dressing percentage and ratio of kidney fat/.

RESULTS AND DISCUSSION: Experiment 1. Mean values for performance and carcass quality of young fattening bulls are summarized in Table 1. Fattening of purebred Holstein-Friesians and Holstein-Friesian x Limousin crossbreds was finished at similar final weights and lasted for the same age. Findings reveal that weight gain per day of life did not differ significantly between groups. The animals were fattened up to final weights which could meet the requirements of meat industry. No essential differences were obtained for the weight of eighter internal organs that might have concern to further processing into edible products /liver, spleen, kidney, lung, heart, rumen/. On the contrary, weight of kidney fat removed from the body cavity at slaughter was higher in Holstein-Friesian x Limousin crossbreds than in their straightbred counterparts /$P < 0.05$/. Similar tendency was established for kidney fat percentage, the difference, however, did not seem to be significant at 5 per cent level of probability.

Marked difference was shown for dressing percentage in favour for the crossbred group /$P < 0.05$/. Mean values for Holstein-Friesian and Holstein-Friesian x Limousin were 57.4 and 59.4 per cent, respectively. No essential change of the weight and ratio of joints /neck, chuck and ribs, shoulder and forshin, brisket and plate, loin, flank, tenderloin, round and hindshin/ was found due to commercial crossing of the present Holstein-Friesian dairy population with Limousin sires.

On the contrary, marked difference was found between means of rib eye area measured between the 12th and 13th ribs with higher values in Holstein-Friesian x Limousin crossbreds than in straightbred Holstein-Friesian young bulls /101.0 cm^2 and 87.6 cm^2, respectively/.

Ratio of meat and fat in the carcass as well as that of the meat in valuable cuts tended to be higher for crossbreds as compared to straightbred individuals. The differences, however, were not significant at 5 per cent level of probability. Significant difference has been established between means of both amount and ratio of bone for the straightbred and crossbred animals /$P < 0.05$ and $P < 0.01$, respectively/. This phenomenon might be attributed to the well known fine bony structure of Limousin breed.

Table 1

Average performance of purebred HF and HF x L crossbred young fattening bulls

Item	HF /n=8/	HFxL /n=8/
Age in days	503	499
Final weight /kg/	516	521
Live weight prior to slaughter /kg/	501	506
ADWG per day of life /g/	1031	1061
Weight of internal organs /kg/		
Liver	5.5	4.9
Spleen	1.9	2.4
Kidney	1.0	0.9
Lungs	4.3	3.9
Heart	2.2	2.0
Rumen	9.2	9.5
Kidney fat /kg/	5.3[a]	6.3[b]
/%/	1.8	2.1
Carcass weight /kg/	288	301
Dressing percentage	57.4[a]	59.4[b]
Net ADWG /g/	575	602
Weight of /right/ half carcass dissected /kg/	142.0	149.3
Joints		
Neck /kg/	15.8	16.7
/%/	11.1	11.2
Chuck and ribs /kg/	14.8	15.4
/%/	10.4	10.3
Shoulder with foreshin /kg/	24.7	25.5
/%/	17.4	17.1
Brisket and plate /kg/	21.3	22.8
/%/	15.0	15.2
Loin /kg/	7.7	8.3
/%/	5.4	5.5
Flank /kg/	8.9	9.6
/%/	6.3	6.4
Tenderloin /kg/	2.7	3.0
/%/	1.9	2.0
Round and hindshank /kg/	45.3	47.1
/%/	31.9	31.6
Tail /kg/	1.1	1.2
/%/	0.8	0.8
Rib eye area /cm^2/	87.6[a]	101.0[c]
Major tissues		
Lean /kg/	103.6	109.7
/%/	72.8	74.5
Fat /kg/	11.0	12.7
/%/	7.8	8.6
Bone /kg/	27.7[a]	24.7[b]
/%/	19.5[a]	16.8[c]
Ist class lean /%/	32.5	34.4

a - b = $P < 0.05$

a - c = $P < 0.01$

Thus, findings of our preliminary study /Szűcs and co-workers, 1988/ could be reconfirmed. In another study /Csukly and co-workers, 1986/ ratio of joints in carcasses, ratio of meat, fat and bone within carcasses were investigated in Hungarian Red Spotted, Holstein-Friesian, Hungarian Grey and Hereford young fattening bulls. Animals were slaughtered serially at 200, 350 and 500 days of age, respectively. Among breeds 2-3 per cent differences were found for the ratio of joints. Over and above that increased level of variability was established for the ratio of lean, bone and fat in the breeds mentioned above. The highest lean ratios were recorded in Hungarian Red Spotted and Hereford at 500 days of age. Holstein-Friesian and Hereford tended to have increased bone ratios at same age. Ratio of lean in carcass seemed to increase with advancing age in all breeds but Holstein-Friesian. Ratio of fat increased and that of bone decreased in all breeds with age. The effect of breed on meat, bone and fat in joints manifests itself first of all according to maturity type. Although extreme types in maturation may show significant differences for the distribution of tissues separated, the extent

of these differences are often minor. In a series of Danish crossbreeding experiments /Berg and co-workers, 1978 a, b, c, d/ close similarity were found among paternal breed groups for muscle and bone weight and distribution. Fat deposition seemed to follow a common pattern, as well. Consequently, variation and the proportion of tissues may be attributed to maturation and the proportion of muscles with higher slaughter weight may decrease irrespective of paternal sires. Late-maturing types would have higher proportion of higher priced cuts if marketed at similar final weights. At same total muscle weight in carcasses of young fattening bulls sired by Charolais vs. Hereford bulls can attain 3 per cent difference in pistol muscle. If slaughter weight is in proportion to the actual mature weight of a given genotype, differences in muscle weight distribution would be small /Berg and co-workers, 1978 b/. According to the findings published by Liboriussen and co-workers /1982/ Charolais crosses showed highest growth rate, followed by Simmental, Blonde d'Aquitaine, Romagnola, Belgian Blue and White and Chianina crosses. Young bulls sired by Piemontese, Blonde d'Aquitaine, Belgan Blue and White and Limousin had the best carcass quality in terms of high lean/bone ratio.

In Renand's study /1985 a, b/, where progeny of Frisonne and Normande dairy cows and different beef breeds including Blonde d'Aquitaine, Charolais and Limousin sires, as well as Coopelso 93 and Inra 95 double muscled synthetic sires were examined young bulls from Charolais sires showed the highest growth, 5 and 10 per cent higher than that from Blond d'Aquitaine and Limousin ones, respectively. Apart from meat quality traits all variables measured on carcasses were significantly affected by sire breed. Evaluation according to rib eye area and dressing percentage, however, did not follow the same rank order, where Inra 95 had the highest values and Limousin the lowest ones.

Chemical composition of samples taken from rumen, heart, M. longissimus dorsi /LD/, M. psoas major /PS/ and M. gluteus medius /GM/ is presented in Table 2. Only slight interbreed differences could be established between mean values in this study. Differences of chemical composition among slaughter byproducts and muscles are obvious. Tissue samples taken from rumen contained relatiively low amounts of protein and showed high fat levels. The muscle of heart also tended to have lower protein and higher fat contents than any other muscle. Anyway the chemical composition of muscles are comparable with the results of previous studies carried out on animals of similar or same age, sex and weight. Sørensen and Buchter /1985/ found large interbreed fifferences among crossbred young fattening bulls for intramuscular fat. The highest values were shown for Angus and Hereford, the lowest ones for some continental breeds such as Charolais, Blue Belgian, Piemontese, Romagnola and Blonde d'Aquitaine and for native dual purpose breeds /Danish Red and White, Danish Black and White/. Thus, sires of these breeds were used as paternal breed on Danish dual purpose cattle. Muscle samples /LD/ were taken from carcasses of young fattening bulls. In a previous study /Szűcs and co-workers, 1985/ meat quality properties of several muscles /M. longissimus dorsi, M. semitendinosus and M. psoas major/ of Hungarian Red Spotted, Holstein-Friesian, Hungarian Grey and Hereford young fattening bulls were compared at 200, 350 and 500

Table 2

Chemical composition of selected tissues /%/

Tissue sample	Item	HF	HFxL
Rumen	Moisture	73.5	71.4
	Protein	14.8	16.5
	Intramuscular fat	10.5	11.7
Heart	Moisture	72.2	74.3
	Protein	20.9	20.0
	Intramuscular fat	5.0	4.7
M. longissimus dorsi /LD/	Moisture	74.8	74.9
	Protein	23.5	23.2
	Intramuscular fat	2.2	2.2
M. psoas major /PS/	Moisture	73.9	75.9
	Protein	21.5	21.3
	Intramuscular fat	4.1	2.4
M. gluteus medius /GM/	Moisture	76.1[a]	75.1[b]
	Protein	22.1	22.5
	Intramuscular fat	2.1	2.3

a - b = $P < 0.05$

days of age, respectively. High rate of increase of intramuscular fat with advancing age was shown in PS for all breeds with lowest level, however, for Hungarian Red Spotted. The early maturing breeds such as Hereford tend to deposit intramuscular fat at younger age than the medium maturing Holstein--Friesian or the late maturing Hungarian Grey. The change of intramuscular fat seemed to be an age--linked trait with direct relation to maturity type. For palatability the optimum level of intramuscular fat should attain at least 3 per cent Boccard /1985/ says. It is generally accepted that muscles of young animals contain high amounts of moisture /Szűcs and co-workers, 1985/. Protein content may vary, although the range of values is rather low.

Experiment 2. In a separate study carcass evaluation records of slaughter cattle fattened at the same farm under similar feeding and housing conditions have been analized. Number of animals classified according to sex and breed /straightbred HF vs. crossbred HFxL/ are presented in Table 3. Distribution of carcasses across classification categories are shown in the table, as well.

The distribution of carcasses differed considerably across classification categories between purebred Holstein-Friesian slaughter cattle and Holstein Friesian x Limousin crossbreds. As many as 46 per cent, a high share, of HFxL male carcasses went to the best /extreme/ category. Combined share of carcasses in the extreme /E / and 1st category attained 82 per cent. The same figure for straightbred Holstein-Friesian carcasses was only 66 per cent in males. Similar tendency could be figured out for fattening heifers in terms of distribution of carcasses across classification categories. Preliminary findings /Szűcs and co-workers, 1988/ showed tendencies like this. In another study also marked differences were recorded among three dairy cattle populations for carcass evaluation categories /Szűcs and co-workers, 1986/. Distribution of carcasses of young bulls from a criss-cross breeding scheme developed by Horn /1977/ seemed to differ due to paternal breeds comprising Danish Jersey vs. Holstein-Friesian sires. For comparison straightbred Hungarofries

Table 3.

Number and distribution of purebred HF and HFxL crossbred slaughter cattle across commercial classification categories

Distribution of carcasses across classification categories /%/ [1]	Young bulls		Heifers	
	HF	HFxL	HF	HFxL
	n = 383	72	159	58
E [2]	27	46	30	48
1	39	36	54	52
2	19	10	11	-
3	15	8	5	-

[1] Criteria for standard commercial classification /MSZ 6915-1979/

Classification category	Slaughter weight /kg/ ≥	Dressing percentage ≥	Kidney fat /%/ <	Carcass weight /kg/ >
E ♂	450	58.5	1.6	100
♀	430	57.0	2.2	100
I ♂	450	56.0	-	-
♀	430	54.0	-	-
II ♂	450	54.0	-	-
♀	400	52.0	-	-
III ♂	450	-	-	-
♀	400	-	-	-

[2] Extreme carcass quality

animals were used, a synthetic breed consisting of constant HF and DJ gene ratio /75 and 25 per cent, respectively/. Distribution of carcasses among classification categories reveal the superiority of crossbred animals above their straightbred counterparts.

Detailed figures for performance and carcass evaluation of straightbred Holstein-Friesian vs. crossbred Holstein-Friesian x Limousin young bulls are summarized in Table 4. It is easy to recognize that the producer's endeavours concerning quality of marketed animals have unanimously been oriented by the requirements of the slaughter house. Both age and final weight were slightly lower for animals in the 2nd and 3rd categories although average weight gain proved to be similar, 1 kg, per day of life. Carcass weights seemed to follow the tendencies mentioned above. Consequently,,relation of daily weight gain to daily carcass gain might be obvious.

Criteria prescribed by classification categories seemed to be reflected the means of dressing percentage. In spite of this actual values tend to be higher for HFxL carcasses than for straightbred HF ones. As a consequence of the criteria of carcass classification scheme applied no differences were found between mean values for the amount and ratio of kidney fat that could be attributed to the breeding system investigated in this study.

Figures for performance and carcass merit of heifers are compared in Table 5. It has to be noted that females were slaughtered at higher age and lower final weight than young bulls. As it was expected female stock grew at a slower rate attaining lower daily weight and carcass gain per day of life than males. Thus, lower carcass weights were recorded. Female carcasses seemed to contain higher amounts fo perinephric fat.

Table 4

Performance and classification results of HF vs. HFxL young bulls within categories /$\bar{x}$/

Item	Genotype	Classification categories			
		E	1	2	3
Age in days	HF	520	515	503	482
	HFxL	536	525	489	488
Final weight /kg/	HF	504	509	496	475
	HFxL	513	492	483	464
Weight gain per day of life /g/	HF	994	1014	1012	1005
	HFxL	969	954	1004	974
Slaughter weight /kg/	HF	471	476	464	445
	HFxL	480	459	452	433
Carcass weight /kg/	HF	281	268	255	231
	HFxL	292	265	249	230
Net daily weight gain /g/	HF	554	533	520	489
	HFxL	552	514	517	484
Dressing percentage	HF	59.5	56.3	54.9	51.9
	HFxL	60.9	57.7	55.2	53.1
Kidney fat /kg/	HF	6.0	6.6	5.1	4.0
	HFxL	5.5	6.3	4.5	4.8
Kidney fat /%/	HF	1.2	1.5	1.1	0.9
	HFxL	1.1	1.4	1.0	1.1

Table 5

Performance and classification results of HF vs. HFxL heifers within categories /$\bar{x}$/

Item	Genotype	Classification categories			
		E	1	2	3
Age in days	HF	585	591	636	695
	HFxL	561	553	-	-
Final weight /kg/	HF	429	442	460	483
	HFxL	418	437	-	-
Weight gain per day of life /g/	HF	766	770	747	710
	HFxL	756	811	-	-
Slaughter weight /kg/	HF	401	413	429	451
	HFxL	391	408	-	-
Carcass weight /kg/	HF	226	229	228	238
	HFxL	232	236	-	-
Net daily weight gain /g/	HF	408	401	371	351
	HFxL	420	439	-	-
Dressing percentage	HF	56.4	55.5	53.0	52.9
	HFxL	59.5	57.9	-	-
Kidney fat /kg/	HF	6.8	8.3	6.0	3.4
	HFxL	6.5	9.8	-	-
Kidney fat /%/	HF	1.7	2.0	1.4	1.0
	HFxL	1.7	2.4	-	-

All of the carcasses of heifers from FHxL commercial crossing went to E and 1st class categories according to the classification scheme applied. On the contrary, anly 50 per cent of straightbred Holstein-Friesian females were found to meet the criteria of the 1st category and 30 per cent went to the extreme /E/ category /Table 3/. What is more, several carcasses went to the 2nd and 3rd classes /11 and 5 per cent, respectively/. Thus, shift of carcasses across classification classes might be attributed to the direct effect of commercial crossing for both male and female stock. The improved carcass quality of cross-bred animals has been recognized by the meat industry paying higher prices for their carcasses which resulted in increased profitability as compared to the straightbred Holstein-Friesians.

CONCLUSIONS:

1. If the reproductive status, number of available heifers needed for replacement and the culling rate of a given cow herd allow introduction of commercial crossing would be worthy to be considered on the low producers of Holstein-Friesian herds with Limousin sires.

2. Application of this production system may result first of all in improved carcass yields and dressing percentage. This conclusion has been supported by the findings of this study showing significant improvement of carcass quality of HFxL crossbreds over their straightbred HF counterparts.

3. As far as the amount of dissected meat and ratio of valuable cuts are concerned superiority of commercial crossing of HF cows with L sires could be established.

4. Due to the sceleton system carcasses of slaughter cattle from Limousin sires tend to have lower amounts and ratios of bone than straightbred Holstein-Friesians.

5. As for the chemical composition /moisture, protein and intramuscular fat/ no essential differences seem to be present due to the breeding strategies applied in this study. Differences among tissues are obvious.

6. Marked differences were found between crossbred and straightbred animals for the distribution of their carcasses across classification categories. High share of extreme /E/ and 1st class carcasses among Holstein-Friesian x Limousin slaughter cattle has to be emphasized.

7. Experimental work has to be extended on further paternal beef sires. Investigations are in progress the aim of which is to clarify the effect and usefulness of the procedure in dairy herds under Hungarian conditions.

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