# Slaughter qualities and by-product yield in Limousin bull calves of different genotypes

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**Abstract.** The study aimed to provide a comparative analysis of post-slaughter performance and by-product yield obtained from purebred Limousin bull calves of different genotypes. The purposes of the study were to fatten bull calves, offspring of mothers of different origin, as well as carcasses and by-products obtained as a result of their control slaughter. The bull calves were raised according to the technology of beef cattle breeding with elements of resource saving. The control slaughter of the bull calves was carried out when they reached the required meat condition at the age of 18 months. In the course of the research, it was established that the bull calves obtained from mothers of French selection significantly exceeded ($p<0.01$) the peers obtained from mothers of Australian origin in live pre-slaughter weight of 34.6 kg (6.5%), in carcass weight of 30.8 kg (9.8%); in slaughter weight of 30,6 kg (9.4%). Bulls derived from local selection mothers had significantly ($p<0.05$) higher slaughter weight by 16.3 kg (4.4%) compared to peers whose mothers were of Australian origin. Significant differences between groups in weight and yield of byproducts were not revealed; however, there was a tendency to increase the weight of organs in the groups of animals with high preslaughter live weight (bull calves of the first and third experimental groups). Based on the obtained data, it can be assumed that breeding of the ancestors of the studied animals for a long period of time under conditions of different breeding, housing and feeding technologies influences the meat qualities of carcasses obtained by their offspring, Limousin bull calves, which are descendants of mothers of different origin.

## 1 Introduction

Specialised beef cattle breeding serves as a source of high-quality "red meat" production and is one of the strategic directions of animal breeding [1, 2]. It is known that meat productivity and beef quality can vary significantly and depend on the conditions of animal housing and

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the degree of its resistance to external stimuli, the level of feeding, sex, age, and breed characteristics [3-6]. Abundant feeding of young animals creates conditions for an increased level of redox processes, rapid growth, and accelerated development. Abundant feeding of animals that have finished growth accelerates the process of fat formation, which takes place in conditions of reduced level of metabolic processes. Underfeeding changes the ratio and increases the specific weight in the total body weight of the stomach and intestines, as well as the heart, lungs, head, limbs, skin. Fat deposition and slaughter yield decreases [7]. Thus, different levels of feeding affect meat productivity and by-product weight [8-10]. It was determined that the mass of by-products changes with age, so the mass of by-products of 1 category increased at slaughter at the age of 15 months by 5.4 %, at the age of 18 months - by 34.8 %, at the age of 24 months - by 34.1 % and at 2.5 years - by 67.1 %; the growth of the mass of by-products of 2 categories, respectively, was 5.7; 15.9; 53.3 and 64.1 % [7].

To date, a certain gene pool of specialised beef cattle, including Limousin breed of different origin, has been formed in the Republic of Bashkortostan.

In this regard, the aim of the study was a comparative analysis of post-slaughter parameters and yield of by-products obtained from purebred bull calves of Limousin breed of different genotypes. The objectives of the research included the study of slaughter qualities of bull calves of different genotypes, as well as weight and yield of by-products.

## 2 Materials and methods

The objects of the research were fattening bull calves (Meat Union of Bashkir Producers LLC, Kuyurgazinsky district of the Republic of Bashkortostan) offspring of mothers of different origin and carcasses and by-products obtained as a result of their control slaughter. Cattle breeding is carried out according to the stall-pasture technology with elements of resource saving. For research we formed 3 experimental groups I group - bull calves obtained from mating of cows of French origin and bulls of domestic selection (n=12), II group - bull calves obtained from mating of cows of Australian origin and bulls of domestic selection (n 12), III group - bull calves obtained from mating of cows and bulls of local selection (n=12). The bulls were reared according to the cow-calf system, weaning from mothers was carried out at the age of 8 months before stabling, then growing up, first and second periods of fattening were carried out. Control slaughter of bull calves was carried out in conditions of Meleuzovsky Meat Processing Plant Ltd. when they reached the required meat condition at the age of 18 months.

Carcass category and beef class, including such indicators as thickness of subcutaneous fat, colour of muscle tissue on cross section, colour of subcutaneous fat, were determined according to GOST 33818-2016. Post-slaughter evaluation of meat productivity was carried out by carcass weight (%), carcass yield (kg), internal fat weight (kg), fat yield (%), slaughter weight (kg), slaughter yield (%). The weights of individual organs were determined by weighing on scales (kg). The by-product yield was calculated as the ratio of organ weight to the pre-slaughter weight of the animal and expressed in %.

According to the results of the experiment, a comparative intergroup evaluation of post-slaughter parameters and by-product yield from bull calves of different genotypes, whose mothers were of different origin, was carried out in order to establish superiority in the studied parameters. Arithmetic mean (M) and standard errors of mean values (±m) were calculated. Student's t-test was used to identify statistically significant differences between groups. Statistical processing of the study results was performed using the software application "Excel" from the Microsoft Office package and STATISTICA 5.0.

## 3 Results

All carcasses obtained from bull calves of different genotypes were assigned to the highest category B according to GOST 33818-2016. The carcasses were visually characterised by full-meatness with rounded, convex and well-developed musculature, and were wide when viewed in profile. The hips were broad and flat, the overhang of the thigh muscles at the knee joint was well expressed, the back and loin were broad and thick almost to the withers, the spinous processes of the vertebrae were not visible; the shoulder blades and chest were very rounded and well filled with muscle, there was no interception behind the shoulder blades, the scapular bone was not visible due to the thick layer of muscle. The thickness of subcutaneous fat, colour of muscle tissue on cross section, colour of subcutaneous fat corresponded to the specified category.

The results of the control slaughter are shown in Figures 1 and 2.

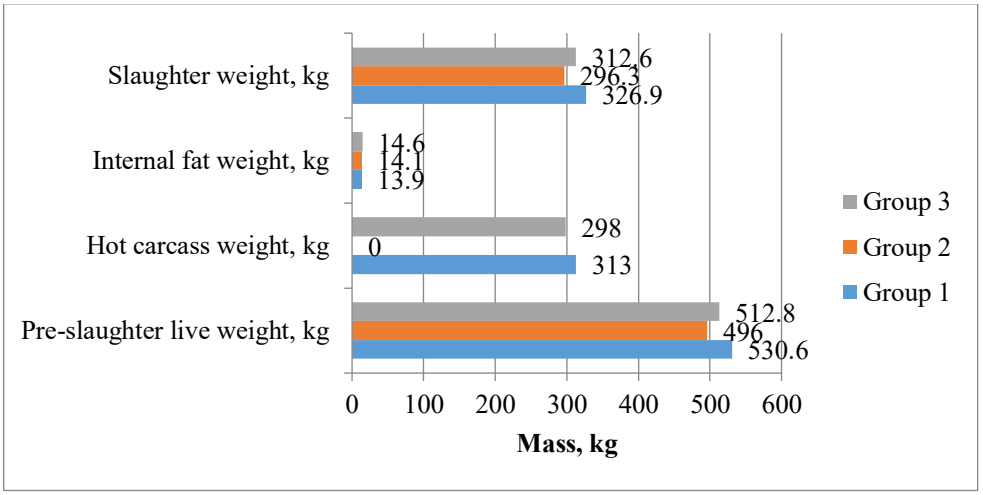


**Fig. 1.** Results of control slaughter of bull calves of different genotypes

During the research it was noted that bull calves of the 1st experimental group, whose mothers are of French origin, were significantly ($p<0.01$) leading in comparison with their peers of the 2nd group (mothers of Australian origin) in pre-slaughter live weight by 34.6 kg (6.5%), in carcass weight - by 30.8 kg (9.8%); in slaughter weight - by 30.6 kg (9.4%). There was a tendency for the 1st experimental group to be higher than the 3rd group (mothers of local selection) in pre-slaughter live weight by 17.8 kg (3.4%); in carcass weight by 15 kg (4.8%); in slaughter weight by 14.3 (4.4%). There was a significant ($p<0.05$) increase in slaughter weight of bull calves of the 3rd group compared to the 2nd group by 16.3 kg (4.4%). No intergroup differences in internal fat content were revealed.

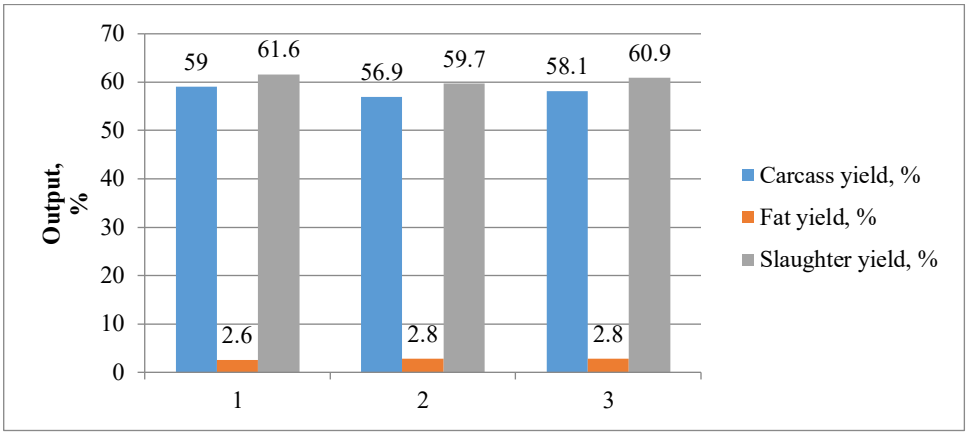


**Fig. 2.** Output

The same picture is observed in terms of product yield. Carcass yield ($p<0.01$) and slaughter yield ($p<0.05$) in the 1st experimental group are significantly higher than in the 2nd group by 2.1% and 1.9%, respectively. When comparing the indices of the 1st and 3rd experimental groups, no reliable intergroup differences in carcass yield and slaughter yield were found, but in the 1st group an excess of 0.9% and 0.7% was observed. There was a significant ($p<0.05$) excess of 1.2% in the slaughter yield of the 3rd experimental group compared to the 2nd group. There was a tendency to increase the fat yield index in the 2nd and 3rd groups by 0.2%.

Weight and yield of by-products of experimental bull calves are given in Table 1.

**Table 1.** Weight and yield of by-products from carcasses of bull calves of different genotypes

| Index | Group | | | | | |
|---|---|---|---|---|---|---|
| | 1 group | | 2 group | | 3 group | |
| | mass, kg | output, %* | mass, kg | output, %* | mass, kg | output, %* |
| Heart | 1.94±0.12 | 0.36 | 1.72±0.10 | 0.34 | 2.06±0.14 | 0.4 |
| Liver | 4.98±0.2 | 0.94 | 4.56±0.14 | 0.92 | 4.6±0.17 | 0.90 |
| Lights | 2.68±0.16 | 0.5 | 2.40±0.12 | 0.48 | 2.70±0.18 | 0.52 |
| Kidneys | 0.92±0.10 | 0.17 | 0.89±0.12 | 0.18 | 0.86±0.10 | 0.16 |
| Spleen | 1.0±0.06 | 0.19 | 0.9±0.08 | 0.20 | 0.86±0.04 | 0.17 |
| Tripe | 7.22±0.42 | 1.36 | 6.9±0.36 | 1.4 | 6.56±0.40 | 1.3 |

* to pre-slaughter live weight.

The analysis of the obtained data on weight and yield of by-products from carcasses of experimental bull calves did not reveal reliable intergroup differences. At the same time, there is a tendency of increase of weight and by-product yield from carcasses of bull calves of the 1st and 3rd experimental groups, in these groups relatively high indicators of pre-slaughter live weight are observed (Fig.1). No definite tendency was observed for by-product yield, and no connection of this indicator with pre-slaughter live weight was observed. Thus, the 3rd experimental group was the leader in heart and lung yield, the indices in this group were higher than in the 1st group by 0.12% and 0.2%; than in the 2nd group - by 0.34% and 0.3%, respectively. The liver yield tended to increase in the 1st experimental group by 0.02% compared to the 2nd group and by 0.4% compared to the 3rd group. In terms of kidney, spleen and tripe yield, the 2nd experimental group had an advantage, where the excess compared to

the 1st group was 0.01%, 0.01% and 0.04%, compared to the 3rd group - 0.02%, 0.03%, and 0.1%, respectively.

## 4 Discussion

In the course of research, it was determined that the best post-slaughter meat qualities were possessed by bull calves descended from French and local breeding mothers. Thus, the progeny of French breeding mothers significantly ($p<0.01$) exceeded ($p<0.01$) the coevals obtained from mothers of Australian origin in pre-slaughter live weight by 34.6 kg (6.5%), in carcass weight by 30.8 kg (9.8%) and in slaughter weight by 30.6 kg (9.4%). Bull calves derived from mothers of local selection had significantly ($p<0.05$) higher slaughter weight by 16.3 kg (4.4%) compared to peers whose mothers were of Australian origin.

The established regularities are most likely due to many years of selection work with ancestors aimed at increasing the meat qualities of cattle, precocity and adaptability to use under conditions of intensive fattening. The offspring of Australian breeding mothers were inferior to their peers in slaughter qualities by physique, because in this case selection was aimed at the possibility of breeding under conditions of maximum possible resource conservation [11].

The data obtained by us are consistent with the data of other authors. For example, at the comparative analysis of meat qualities of bull calves of Aberdeen-Angus breed of American origin and animals of Australian selection the superiority of the former in carcass yield 58.4% vs. 56.9% and slaughter yield 59.7% vs. 58.0% was noted; also, insignificant difference in the weight of by-products from 0.3 to 0.5 kg was established [12]. It was established that there were no reliable differences in the absolute weight of heart, liver, lungs and kidneys of the studied animals [13]. It was found that the weight of the liver, lung, legs and hide increases with the increase in carcass weight: a very close direct correlation was found between these indicators [14].

Based on the above, it can be assumed that breeding of animals for a long period of time under conditions of different housing and feeding technologies influenced the exterior features of the studied representatives of Limousin cattle with ancestors of different origin and, as a consequence, the indicators of post-slaughter evaluation of carcasses.

## 5 Conclusion

It was found that bull calves derived from mothers of French selection significantly ($p<0.01$) exceeded ($p<0.01$) the peers derived from mothers of Australian origin in terms of pre-slaughter live weight by 34.6 kg (6.5%), carcass weight by 30.8 kg (9.8%) and slaughter weight by 30.6 kg (9.4%). Bulls derived from local selection mothers had significantly ($p<0.05$) higher slaughter weight by 16.3 kg (4.4%) compared to peers whose mothers were of Australian origin.

No significant differences between groups in weight and yield of by-products were revealed; however, there was a tendency to increase the weight of organs in groups of animals with high pre-slaughter live weight (bull calves of the 1st and 3rd experimental groups). As for the yield of byproducts, no tendency of its correlation with preslaughter live weight was revealed.

Based on the obtained data, it can be assumed that breeding of the ancestors of the studied animals for a long period of time under conditions of different breeding, housing, and feeding technologies influences the meat qualities of carcasses obtained by their offspring, the studied Limousin bull calves, which are the offspring of mothers of different origin.

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