ANALYSIS OF THE INFLUENCE OF SEX ON THE CARCASS VALUE OF THE CROSSBRED PIG POPULATIONS*

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The objective of this paper was to evaluate an influence of sex on the level of carcass value in 8 final hybrids pigs most frequently bred in our large scale production using station tests. For this purpose 720 pigs (360 barrows as well as 360 gilts) divided into 8 genotype groups were tested according to methodology for testing pure-bred and hybrid pigs so that the principle of animal housing in pairs were used. The followed genotypes LW_s x (LW_m x L), D x (LW_m x L), PN x (LW_m x L), (LW_s x BL) x (LW_m x L), (PN x D) x (LW_m x L) as well as (PN x H) x (LW_m x L) were used. After reaching the total average live weight 104.8–115.2 kg at the age of 156–194 days from their birth, the quantitative carcass analysis was made and obtained results were converted by means of the linear model with fixed effects to a uniform weight of 90 kg. On the basis of the results one could say that sex in the monitored genotypes significantly influenced percentage of meat in the carcass, while the differences between the sex amount roughly to 2% for the benefit of sows. Also significant differences exist within one monitored sex among various genotypes in percentage of meat in barrows, or sows. It was documented, that sex significantly influences meat/fat formation in the carcass, while inter-sex differences were in the interval 3.4–7.7%, respectively 13%. While gilts participated in variability of carcass body percentage composition more significantly in all monitored combinations, impact of sex on meat quality was not proved.

pig; genotype; testation; sex; carcass value

INTRODUCTION

The present market requirements for pig production with a minimum fat share influence all breeding activities as well as nutrition. It is related to many breeding and organizational measures leading to optimization of the degree of genotype and phenotype integration. It reflects in metabolic processes of organism, like functions of effectiveness of breeding animals and like growth of body components in slaughter animals (Hovorka, 1989).

Carcass value represents amount and quality of products, which are obtained by processing of slaughter animals after being slaughtered in the processing industry (Glodek, 1988; Russo, 1988). It has decisive importance on evaluation of slaughter animals purchased and delivered to slaughter houses and it is the lead for evaluation of breeding work in the section of hog breeding (Merks, Hannenberg, 1998).

As carcass value is a property of effectiveness, like other ones, with additive impacts of genes, its manifestation is a result of genetic factors and the environment. With a view to the fact that it takes part in the price of the product and its consuming significantly, it is important to know the influence of the most important genetic factors, which have the most significant impacts. Breed/line/genotype and sex belong among them.

The impact of breed/line/genotype shows in various abilities of meat creation and fat deposition, while the cause is based on various degrees of the breed earliness and ways of its breeding (Close, 1994). Various pig genotypes – though they consume approximately identical amount of proteins in feeding, i.e. nitrogen, they use it in various ways, which is directly related to various intensity of generation of muscles (Šmanenkov, 1967; McConnell et al., 1972; Adamec, 1991; Bučko et al., 2001).

With a view to the fact that individual quantitative signs of carcass values show high heritability, application of selection in a relevant direction uses to be highly effective (Jakubec et al., 1974; de Vries, 1989; Sellier, Rotschild, 1991; de Vries, Kains, 1994). In this respect the studies of farm animals' carcass values, i.e. pigs as well, concentrate mainly on analyses of inter-breed differences in presence of individual body components, i.e. variability of the ratio between meat, fat, bones, as well as slaughter yield capacity, percentage of valuable and less valuable parts, which are important both during hybridization programs compilation and genotype selection (Hovorka, 1989; Dickerson, 1969; Poděbradský, 1980; Poděbradský, Jakubec, 1982).

The influence of sex, or as the case may be, castration, also significantly influences utilization and conversion of proteins contained in feed into muscles. This applies to carcass value especially after reaching sexual maturity. The influence of sex is negligible until it is reached, i.e.

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up to the weight of 70 kg (Kopecký et al., 1972; Hovorka, 1983; Lenis, Jongbloed, 1994).

While monitoring presence of the individual body parts and components in pigs, it may be stated that smaller amount of separable fat, more meat with non-separable fat (i.e. muscles as well) and higher percentage of bones and skin can be seen in boars' carcass half in comparison to sows and barrows. The length of fattening is however limited by weight, their fattening by legislation (Šprysl, Hovorka, 1986; Wood et al., 1994).

The reason of difference in generation of carcass products and body components is based on hormones influencing development of secondary sexual traits, nerve system, i.e. temperament, which is manifested in intensity of nutrients conversion, especially intensity of growth processes (Hanson, 1974; Šprysl, 1980; Stupka et al., 2002).

Despite of the fact that sex influences as well as genotype are known (Hanson, 1974; Brandt, 1985; Hovorka, 1989), assessment of its percentage in present populations of hybrid pigs for utility breed is problematic. It is caused by the fact that many breeds do not apply separated fattening according to sex due to various reasons, so that pig producers mostly do not have information regarding the percentage of differences in effectiveness used for proper implementation of separated fattening of boars and sows. Also the processing industry, though equipped with modern instrumentation (Swatland, 1998) determining percentage of muscles does not implement sorting of the carcass bodies according to sex. Therefore, it is obvious that utilization of sex of the pigs has not been adequately utilized yet.

Therefore, the objective is specialized on determination of percentage of the individual body components of the present genotypes with a view to sex, which may be better assessed in tests of pigs (Šprysl et al., 2005). This is the way how the genotype may be optimized and percentage of influence to the carcass value by sex may be determined (Stupka et al., 2004).

MATERIAL AND METHODS

Evaluation of influence of sex on level of carcass value in eight final hybrid pigs most frequently bred in our large scale production by using station tests was the objective of the paper. Basically, groups of hybrid pigs were compared, housing of which was implemented in compliance with methodology for testing pure-bred and hybrid pigs, so that the principle of animal housing in pairs was assured. After completion of the test the hybrid pigs of equal sex ratio underwent slaughter analyses. They were of the following genotypes and frequency of groups.

Feeding of pigs was implemented in compliance with the nutrients needs standards in ad-libitum way in three phases with continuous transition, while complete feeding mixtures (CFM) were used containing three components (wheat, barley, soya, premix) and they were optimized with a view to age and weight of pigs. Feeding with CFM was implemented in ad-libitum way in the feeders Duräumat, while these were mixed individually for each pen according to the following feeding scheme:

Nutrient content	Feeding period		
	< 35 kg	35–65 kg	> 65 kg
Protein (g/kg)	196.70	184.00	156.30
MEp (MJ/kg)	13.30	13.20	12.90
Fibre (g/kg)	39.84	38.76	40.75
LYZ (g/kg)	11.40	10.20	8.30
THRE (g/kg)	7.20	6.50	5.40
MET (g/kg)	3.20	2.90	2.40
Ca (g/kg)	7.20	6.80	6.10
P (g/kg)	5.50	5.40	4.60

For evaluation of quantitative part of the carcass value with a view to sex, the pigs were slaughtered after reaching the total average live weight between 104.8 and 115.2 kg at the age of 156–194 days from their birth, sold (SEUROP/ZP-ČSN 466160; Vrchlabský, Palásek, 1992; Pulkrábek, 1994) and they underwent slaughter analyses (Walstra, Merkus, 1996). Within slaughter analyses the following factors were monitored in sows and barrows:

- net weight before slaughter in kg,
- carcass body weight in kg,
- carcass right half weight in kg,
- carcass weight and main meat parts (MMP) percentages in % and kg,
- MLLT-loin eye area at place of the last lumbar vertebra in mm^2,
- lean meat share in %,
- average back fat thickness in mm,
- MLLT electric conductivity (EC) in mS (measured 50 minutes post mortem).

For the purposes of objective analysis of the carcass value properties and comparison of the individual indicators between each other, the monitored indicators were converted by means of a linear model with fixed effects to a uniform weight of 90 kg, which corresponds to a live weight of roughly 110 kg. In this case the following model was used:

$$y_i = \mu + a_i + b_j + e_i$$

where: y_i – the monitored variable,
μ – the population mean,
a_i – effect of the i-th genotype,
b_j – effect of the j-th sex
e_i – residual error of an individual

Hybrid combination (sire–dam)	n – ♀	n – ♂	Hybrid combination (sire–dam)	n – ♀	n – ♂
LW_s x (LW_m x L)	120	120	(LW_s x BL) x (LW_m x L)	120	120
D x (LW_m x L)	120	120	(PN x D) x (LW_m x L)	120	120
PN x (LW_m x L)	120	120	(PN x H) x (LW_m x L)	120	120

Results of the tests were evaluated by a statistical program SAS® Propriety Software Release 6.04, and expressed both in charts and graphically, while differences between the individual monitored signs were tested by single/multiple analyses of variance.

RESULTS AND DISCUSSION

Evaluation of the monitored properties characterizing differences in quantitative and qualitative traits of the carcass value of the monitored genotypes of barrows and sows are documented by Tables 1–5 as well as Figs 1–5. The tables also present the calculated levels of significance a for the purposes of comparison of significance in the monitored carcass value traits differences between the barrows and sows within the genotype, while statistically significant difference is highlighted.

It is obvious at first sight out of evaluation of influence of genotype and sex on percentage of meat in the carcass utility body that sex plays an important role and probably influences generation and percentage of meat in hogs (Figs 1 and 2).

Table.1. Survey of carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

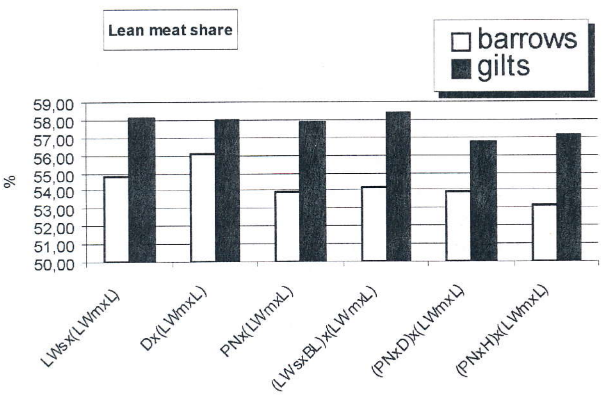
Genotype	Lean meat share (%)				
	barrows (n = 120)		sows (n = 120)		α-level
	$\bar{x} \pm s_{\bar{x}}$	s	$\bar{x} \pm s_{\bar{x}}$	s	
LW_s x (LW_m x L)	54.81 ± 0.55	3.32	$58.16^{A} \pm 0.62$	3.6	0.0001
D x (LW_m x L)	$56.03^{Abcd} \pm 0.48$	2.82	$57.96^{Aab} \pm 0.52$	3.13	0.0193
PN x (LW_m x L)	$53.93^{d} \pm 0.62$	2.58	57.90 ± 0.70	2.79	0.001
(LW_s x BL) x (LW_m x L)	$54.13^{b} \pm 0.61$	3.65	58.32 ± 0.70	4.12	0.0001
(PN x D) x (LW_m x L)	$53.96^{c} \pm 0.44$	2.51	$56.73^{a} \pm 0.71$	4.12	0.0011
(PN x H) x (LW_m x L)	$53.17^{A} \pm 0.72$	3.05	$57.07^{b} \pm 1.22$	5.01	0.0009

Differences among means with the same type are statistically significant
$P \leq 0.01$ A, B, C..., $P \leq 0.05$ a, b, c...

Table 2. Survey of carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

Genotype	Main meat parts (%)				
	barrows (n = 120)		sows (n = 120)		α-level
	$\bar{x} \pm s_{\bar{x}}$	s	$\bar{x} \pm s_{\bar{x}}$	s	
LW_s x (LW_m x L)	$49.45^{A} \pm 0.77$	3.37	$51.22^{a} \pm 0.47$	1.99	0.0461
D x (LW_m x L)	48.66 ± 0.36	1.6	50.43 ± 0.55	2.4	0.04
PN x (LW_m x L)	48.09 ± 1.21	3.42	$51.97^{b} \pm 0.79$	1.94	0.0079
(LW_s x BL) x (LW_m x L)	48.81 ± 0.69	2.29	$51.91^{A} \pm 0.84$	3.34	0.0035
(PN x D) x (LW_m x L)	47.94 ± 0.70	2.21	51.20 ± 1.18	4.1	0.0048
(PN x H) x (LW_m x L)	$46.62^{A} \pm 0.70$	2.23	$49.04^{Aab} \pm 0.56$	1.78	0.0438

Differences among means with the same type are statistically significant
$P \leq 0.01$ A, B, C..., $P \leq 0.05$ a, b, c...



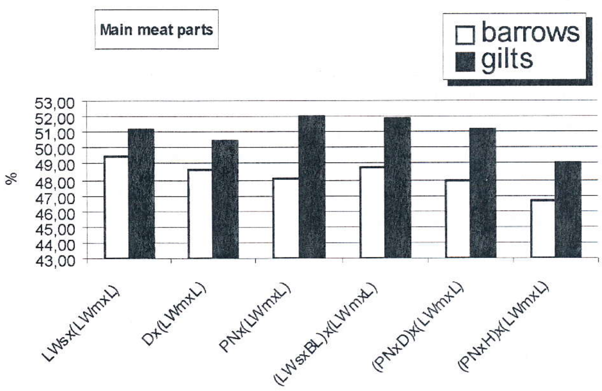


Fig. 1 and 2. Assessment of the carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

Highly significant differences were proved between barrows and sows. They fluctuated between 3.4 and 7.7% for the benefit of sows in the monitored genotypes, while the highest difference was established in combination (LW_s x BL) x (LW_m x L), the lowest in D x (LW_m x L). Barrows of this combination, as it arises from table 1, contrary to others, showed the highest lean meat percentage in the carcass body. Differences between the other barrows are statistically non-significant. If we evaluate differences among sows, then it is obvious that within this sex more significant differences in the monitored traits were proved than in barrows ($P \leq 0.01$, 0.05). Therefore, it is obvious that sows participate more significantly in variability of lean meat percentage in the carcass in the monitored genotypes.

As it is obvious from table listed above, the similar fact like in table 1 was found out in evaluation of MMP percentage. Also here significant inter-sexual differences for the benefit of sows in the interval 1.8 and 4.3% were found, while the highest difference was showed by the combination of (PN x D) x (LW_m x L), the lowest by (LW_s x (LW_m x L).

As regards the impact of sex on generation of MLLT muscle this is documented by Table 3 and Fig. 3. It is ob-

Table 3. Survey of carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

Genotype	MLLT loin eye area (mm^2)				
	barrows (n = 120)		sows (n = 120)		α-level
	$\bar{x} \pm s_{\bar{x}}$	s	$\bar{x} \pm s_{\bar{x}}$	s	
LW_s x (LW_m x L)	4186 ^{Ad} ± 82	355	4600 ^{A} ± 155	637	0.0147
D x (LW_m x L)	5058 ^{ABCD} ± 126	564	5201 ^{Aab} ± 145	631	0.3761
PN x (LW_m x L)	4642 ^{d} ± 163	462	4873 ± 155	379	0.3959
(LW_s x BL) x (LW_m x L)	4482 ^{B} ± 83	286	4938 ± 114	455	0.0189
(PN x D) x (LW_m x L)	4436 ^{C} ± 131	414	4806 ^{a} ± 182	632	0.0873
(PN x H) x (LW_m x L)	4546 ^{D} ± 131	416	4742 ^{b} ± 109	360	0.3741

Differences among means with the same type are statistically significant
$P \leq 0.01$ A, B, C…, $P \leq 0.05$ a, b, c…

Table 4. Survey of carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

Genotype	Average back fat thickness (mm)				
	barrows (n = 120)		sows (n = 120)		α-level
	$\bar{x} \pm s_{\bar{x}}$	s	$\bar{x} \pm s_{\bar{x}}$	s	
LW_s x (LW_m x L)	26.67 ^{FGHID} ± 0.40	2.41	24.92 ^{HD} ± 0.54	3.15	0.0349
D x (LW_m x L)	29.67 ^{D} ± 0.42	2.44	27.07 ^{DEF} ± 0.56	3.36	0.0019
PN x (LW_m x L)	30.18 ^{I} ± 0.70	2.87	23.91 ^{Fa} ± 0.70	2.79	0.0001
(LW_s x BL) x (LW_m x L)	29.04 ^{F} ± 0.69	4.15	24.51 ^{I} ± 0.74	4,34	0.0001
(PN x D) x (LW_m x L)	30.15 ^{G} ± 0.62	3.57	27.52 ^{HK} ± 0.66	3.86	0.002
(PN x H) x (LW_m x L)	30.90 ^{H} ± 0.87	3.68	26.50 ^{a} ± 0.94	3.87	0.0002

Differences among means with the same type are statistically significant
$P \leq 0.01$ A, B, C…, $P \leq 0.05$ a, b, c…

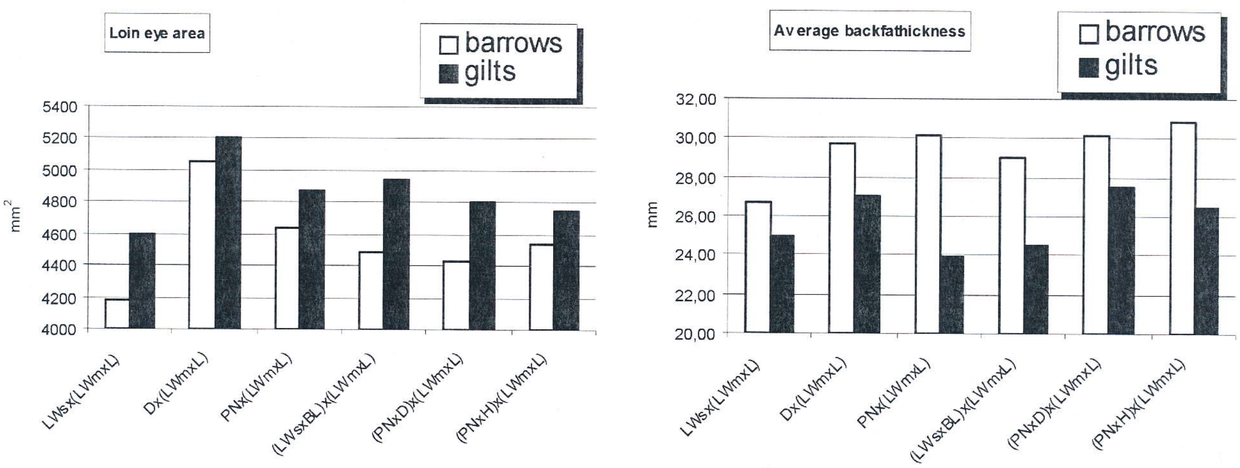


Fig. 3 and 4. Assessment of the carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

Table 5. Survey of carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

Genotype	MLLT – EC (mS)				
	barrows (n = 120)		sows (n = 120)		α-level
	$\bar{x} \pm s_{\bar{x}}$	s	$\bar{x} \pm s_{\bar{x}}$	s	
LW_s x (LW_m x L)	3.81 ± 0.10	0.59	3.83 ± 0.11	0.62	0.9522
D x (LW_m x L)	3.53 ± 0.06	0.36	3.67 ± 0.11	0.69	0.6873
PN x (LW_m x L)	5.31 ± 0.44	1.83	5.51 ± 0.51	2.03	0.6956
(LW_s x BL) x (LW_m x L)	4.25 ± 0.23	1.41	4.54 ± 0.24	1.41	0.3925
(PN x D) x (LW_m x L)	. ± .	.	. ± .	.	.
(PN x H) x (LW_m x L)	3.68 ± 0.21	0.88	3.95 ± 0.36	1.47	0.579

Differences among means with the same type are statistically significant
$P \leq 0.01$ A, B, C..., $P \leq 0.05$ a, b, c...

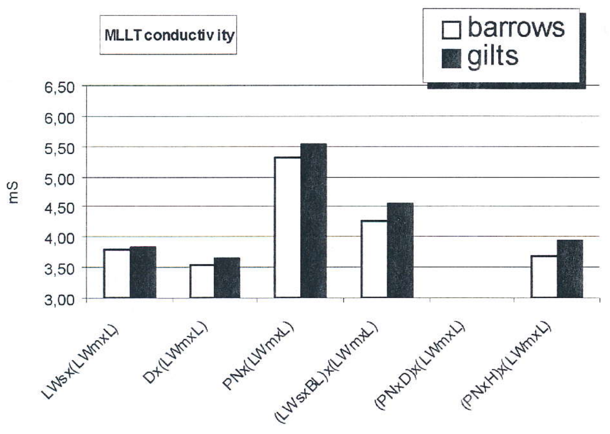


Fig. 5. Assessment of the carcass value with respect to genotype and sex after conversion to uniform carcass weight 90 kg

vious from the results of inter-sex differences in the monitored combinations that significant impact on the monitored sign ($P \leq 0.05$) was found only in hogs of LW_s x (LW_m x L) and (LW_s x BL) x (LW_m x L). As regards assessment of sex impact, regardless genotype, it is obvious that the barrows showed like in previous indicators lower differences between each other than the sows. Similar tendency was proved by Stupka (2003).

Within evaluation of the average fat back thickness with regard to sex it may be stated that significant statistically ($P \leq 0.001$, 0.05) differences (Table 4 and Fig. 4) were found among the genotypes within one sex, in barrovs and sows.

It is obvious that the highest, or the lowest height of the back fat within the group of barrows 30.9, or 26.7 mm was found in genotype (PN x H) x (LW_m x L) or LW_s x (LW_m x L). As regarded sows the greatest height of the back fat was reached by genotype (PN x D) x (LW_m x L) (27.5 mm), the lowest by PN x (LW_m x L), in particular 23.9 mm. It is obvious from table and graph 4 that significant impact of sex on size of the monitored trait was proved and the achieved conclusions of inter-sex differences are the evidence ($P \leq 0.01$). In this respect, the height of the back fat thickness is always higher in barrows, on average by 13%, while the highest difference of 6.27 mm, representing 26.2% was showed by the genotype PN x (LW_m x L), the lowest of 1.75 mm, amounting to 6.5% by the genotype LW_s x (LW_m x L).

As regarded evaluation of the impact of sex on the sign characterizing the qualitative part of the carcass value expressed by electrical conductivity of MLLT – results are shown in Table 5 and Fig. 5.

It is obvious from the results that significance of differences between the male hogs and sows of the monitored genotypes was not proved. Therefore, it may be stated that meat was not influenced by sex, and that variability of meat quality of the present hybrid combinations of slaughter hogs is minimal and it is not influenced by sex (Pour, 1986).

CONCLUSION

- Sex of the genotypes significantly influences percentage of meat in the carcass, while the differences between the sex amount roughly to 2% for the benefit of sows.
- Significant differences exist within one sex among various genotypes in percentage of meat in barrows, or sows.
- Sex significantly influences meat/fat formation, lean meat/fat share in the carcass and MMP, while inter-sex differences were in the interval between 3.4 and 7.7% in respect of the meat percentage, 3.2 and 8.1% in respect of MMP percentage and 13% in fat percentage for the benefit of sows.
- More significant differences in variability of carcass body percentage composition exist in sows than barrows.
- Impact of sex on slaughter length and meat quality was not proved.

Out of this reason, separate fattening shall be recommended for the sphere of commercial breeding.

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ŠPRYSL, M. – STUPKA, R. – ČÍTEK, J. – OKROUHLÁ, M. – KUREŠ, D. (Česká zemědělská univerzita, Fakulta agrobiologie, potravinových a přírodních zdrojů, Praha, Česká republika):

Analýza vlivu pohlaví u různých genotypů na vlastnosti jatečné hodnoty současných hybridních populací prasat.

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Cílem práce bylo zhodnocení vlivu pohlaví na úroveň jatečné hodnoty osmi skupin finálních hybridů prasat, nejčastěji realizovaných v našich užitkových chovech s využitím staničních testů. Za tímto účelem bylo testováno celkem 720 prasat (360 vepříků a 360 prasniček) podle metodiky pro testaci čistokrevných a hybridních prasat tak, aby byla dodržena zásada ustájení zvířat po dvojicích. Jednalo se o genotypy (BU x L) x BO, (BU x L) x D, (BU x L) x PN, (BU x L) x (Bo x BL), (BU x L) x (PN x D) a (BU x L) x (PN x H). Po porážce v průměrné živé hmotnosti 104,8–115,2 kg ve věku 156–194 dní byla provedena kvantitativní jatečná analýza a získané výsledky byly přepočteny pomocí modelu s fixními efekty na společnou hmotnost JUT 90 kg.

Výsledky práce potvrzují, že pohlaví významně ovlivňuje podíl masa v JUT, přičemž rozdíly mezi pohlavími činí cca 2 % ve prospěch prasniček. Rovněž je zřejmé, že v rámci jednoho pohlaví existují průkazné rozdíly mezi různými genotypy v podílu masa u vepříků, resp. prasniček.

Rovněž se prokázalo, že pohlaví výrazně ovlivňuje tvorbu a podíl svaloviny a tuku, přičemž mezipohlavní diference byly v rozmezí 3,4–7,7 % a 13 %. Prokázalo se rovněž, že ačkoliv se na variabilitě složení tělesných podílů JUT výrazněji podílejí prasničky, vliv pohlaví na kvalitu masa se neprokázal.

prase, genotyp, testace, pohlaví, jatečná hodnota

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