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THE EFFECT OF BREED, SIRE AND SEX ON THE QUALITY OF CARCASS SIDES[1]

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Abstract: Investigation of quality variability of pig carcass was carried out on 1443 fatlings (gilts and barrows). They were progenies of 22 (Farm A) and 12 sires (Farm B), 5 breeds-crossbreds (Swedish Landrace, Large White, Duroc, Hampshire, Duroc x Hampshire). Animals were fed with standardised feed mixture semi ad libitum. The quality of carcass sides was determined on the slaughter-line according to *Regulation (1985)*. Investigation included following traits: weight of warm carcass (MTP, kg), meat in carcass sides (KMP, kg and SMP, %), total mass and ratio of leg+shoulder+loin (MFO, kg and UFO, %). Obtained results were processed using several models (*Harvey, 1990)* which included sire genotype, sire, sex progeny and mass of warm carcass (regression effect).

All investigated traits varied under the influence of sire genotype ($P<0.01$) on farm B. The effect of sire genotype was significant ($P<0.01$) on KMP and SMP on the Farm A. All traits of carcass quality varied under the influence of sires. Gilts had higher KMP, SMP, MFO and UFO compared to male castrated heads.

Difference in Total Breeding Value between best and worst boar was 10.41 (Farm A) and 11.24 index point (Farm B).

Key words: pig, quality of carcass sides, breed, sire, sex, breeding value.

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Introduction

Traits of the pig carcass quality vary under the influence of genetic and environmental factors (breed, sires, breeding methods, individuum, age and mass of head of livestock, castration, nutrition, season, procedures prior, during and after slaughtering, etc.). Genotype of sires affects the variability of carcass quality traits of offspring (*Petrović et al., 2004* and *Pušić and Petrović, 2004*), as well as sires within the same genotype (*Petrović et al., 2002; Kosovac et al., 1998* and *Radović et al., 2003*). However, results of some studies show that there are differences between breeds in regard to the effect of sire on variability of traits of the offspring (*Mijatović et al., 2005*) or the sire effect is not significant in different herds (*Bahelka et al., 2004*). Sires within three breeds have affected the variation in the content of meat in the carcass of performance tested sons (*Mijatović et al., 2005*), but boars of two breeds had no effect on depth of m.l.d. in their offspring. There are significant differences in the quality of carcass sides between gilts and male castrated animals as established by *Petrović et al.* (*2004)* and *Pušić and Petrović (2004)*, but such differences weren't established by *Kosovac et al. (1998)*.

Objective of this paper was to evaluate the effect of genetic and environment factors on the quality of fatteners' carcass sides and to evaluate the breeding value of boar-sires.

Material and methods

Research was carried out according to set objective in two pig herds (farm A and B). Investigation included 1443 fatteners (652 female and 791 male castrated heads). They originated from sires of same pure breeds (breeds: Swedish Landrace – SL/ŠL, Large White – LW/VJ, Duroc – D, Hampshire - H) and one combination of two breed crosses (DxH). Investigated offspring in the first herd originate from total of 22 and in the second herd from 12 boars. Offspring is born and raised according to usual technology on our farms. Animals were fed ad libitum using standard complete mixtures. Slaughtering of fatteners was carried out successively in one slaughterhouse but in the same season of single year. After slaughtering and primary processing weight of warm carcass sides and back fat thickness in two points were measured (DSL – back between 13th and 15th vertebra and DSK – sacral vertebra where *m. gluteus medius* mostly grows into fat), and after 24 h cooling period so called «French» processing of carcass sides was carried out (leg+shoulder+loin) and parts of the carcass side were individually measured.

Investigation included following traits: weight of warm carcass sides (MTP, kg), daily gain of carcass sides (DPP, g), quantity (KMP, kg) and content of meat in carcass sides (SMP, % - according to *Regulation*,1985), total weight (MFO, kg) and share of «French» processed carcass side in weight of warm carcass sides (UFO, %). All individuums whose weight of warm carcass sides after slaughtering was below 65 and above 113 kg were excluded from further analysis.

Obtained data was processed using several Least square models (*Harvey*, 1990) which included sire genotype, sire of the fattener, sex and weight of warm carcass sides (independent variable). Average values and variability of investigated traits were evaluated based on same average weight of warm carcass sides (85,78 kg for farm A and 82,59 kg for farm B).

Total breeding value of a boar (UPV) is sum of evaluated breeding values for following traits: DPP (g), KMP (kg) and MFO (kg), evaluated as deviation of the traits registered in offspring from the general average. Obtained values were transformed into index values ((I = 100 + (∑ LSM - μ /μ x 100)). Only the breeding value of boars with more than nine offspring was evaluated.

Results and discussion

Average values and variability of the carcass quality traits are presented in table 1. Average weight of warm carcass sides on fatteners raised on farm A was statistically considerably higher than in fatteners from farm B. Fatteners fro, farm A were younger at slaughtering (204 days) than fatteners from farm B (221 days), since they had more intensive growth and higher average daily gain of warm carcass sides (0,420 compared to 0,373 kg/day). Differences in average values were significant ($P<0,001$). In carcass sides of fatteners from farm A the quantity of meat was higher (by +0,85 kg, $P<0,001$) compared to carcass sides of fatteners from farm B. However, content of meat was lower (by – 0,63%, $P<0,001$) since the sum of back fat thickness measured on two points was higher in fatteners from farm A (37,31 mm) than in fatteners from farm B (32,25 mm). Total weight of leg + shoulder + loin («French» processing of carcass sides) and it share in weight of warm carcass side of fatteners from farm A was higher (by 2,58 kg or 1,11%, $P<0,001$) compared to farm B.

Sire genotype influenced ($P<0,01$) the variation of all investigated traits of offspring from farm B. However, on farm A, sire genotype had no effect ($P>0,05$) on variation of daily gain of warm carcass sides, total weight and share of leg+shoulder+loin. Remaining studied traits (DSL+DSK, KMP and SMP) varied ($P<0,01$) between boar genotypes.

Also, sires had effect on variation of traits of their offspring (table 2). Only for trait DPP no statistically significant variations were determined between female and male castrated heads (P>0,05). All traits of carcass quality depended on the weight of warm carcass sides (P<0,01).

Table 1. Average values and variability of traits of carcass quality of progeny
Tabela 1. Prosečne vrednosti i varijabilnost osobina kvaliteta polutki potomaka

Osobina[1)] Trait	Farma A –Farm A (MPT=85,78 kg)[2)]		Farma B –Farm B (MPT=82,59 kg)	
	μ ± SE	SD	μ ± SE	SD
DPP (g/dan)	420 ± 0,29	48,8	373 ± 0,56	45,7
DSL+DSK (mm)	37,31 ± 0,29	9,66	32,25 ± 0,46	10,08
KMP (kg)	37,10 ± 0,05	4,35	36,25 ± 0,07	4,34
SMP (%)	43,28 ± 0,06	1,73	43,91 ± 0,08	1,54
MFO (kg)	44,96 ± 0,09	4,87	42,38 ± 0,14	4,74
UFO (%)	52,57 ± 0,10	3,20	51,46 ± 0,16	3,44

[1)] DPP- Dnevni prirast toplih polutki (Daily gain of warm carcass, g/day), DSL+DSK – Debljina slanine na ledjima i krstima (Back thickness back+rump), KMP – Ukupna količina mesa u polutkama (Total quantity of meat in carcass sides), SMP – Sadržaj mesa u polutkama (Content of meat in carcass sides), MFO – Ukupna masa francuske obrade polutki (Total mass and ratio of leg+shoulder+loin).
[2)] MTP - Masa toplih polutki (kg) – Weight of warm carcass (kg)

Table 2. Level of significance of factors included in model
Tabela 2. Nivo značajnosti uticaja uključenih u model

Osobina[1)] Trait	Farma A –Farm A				Farma B –Farm B			
	R^2	Otac Sire	Pol Sex	MTP	R^2	Otac Sire	Pol Sex	MTP
DPP (g/dan)	0,976	**	NS	**	0,957	**	NS	**
DSL+DSK(mm)	0,392	**	**	**	0,423	**	**	**
KMP (kg)	0,908	**	**	**	0,921	**	**	**
SMP (%)	0,243	**	**	**	0,212	**	**	**
MFO (kg)	0,792	**	**	**	0,770	**	**	**
UFO (%)	0,357	**	**	**	0,381	**	**	**

NS = P>0.05; ** = P<0.01

However, quality of carcass sides of gilts raised on both farms was better than quality of carcass sides of barrows (table 3). Gilts had thinner back fat (DSL+DSK,) compared to barrows and more meat in carcass sides of same average weight, regardless of the farm.

Total weight of leg, shoulder and loin in gilts was higher by 1,94 kg (farm A) and 1,96 kg (farm B) than in barrows. Share of leg+shoulder+loin was higher by 2,3 and 2,4 % in gilts, respectively. These differences in average values between females and barrows were statistically highly significant (table 2).

Table 3. The effect of sex on the carcass quality
Tabela 3. Uticaj pola na osobine kvaliteta polutki

Osobina[1)] Trait	Farma A –Farm A (MPT=85,78 kg)[2)]		Farma B –Farm B (MPT=82,59 kg)	
	Nazimice Gilts	Kastrati Barrows	Nazimice Gilts	Kastrati Barrows
DPP (g/dan)	420	421	373	373
DSL+DSK (mm)	34,80	40,53	29,60	34,90
KMP (kg)	37,63	36,58	36,58	35,91
SMP (%)	43,89	42,66	44,31	43,52
MFO (kg)	45,93	43,99	43,36	41,40
UFO (%)	53,72	51,42	52,67	50,26

Total breeding value of boars of three breeds was evaluated based on three traits and expressed in the form of index. It represents the sum of evaluated breeding values for traits of DPP, KMP and MFO (table 4).

Table 4. Total breeding value (UPV) of boars-sires (Farm A)
Tabela 4. Ukupna priplodna vrednost (UPV) nerasta-očeva (Farma A)

Otac Sire	Rasa[1)] Breed	n	DPP (g) *LSM*	KMP (kg) *LSM*	MFO (kg) *LSM*	UPV *I*
μ ± S.E.			**420 ± 0,29**	**37,10 ± 0,05**	**44,96 ± 0,09**	
1	VJ	18	418	37,85	46,63	105,25
2	ŠL	9	420	38,23	45,54	104,34
3	D	47	422	37,71	45,89	104,19
4	ŠL	40	423	37,78	45,25	103,19
5	VJ	50	422	37,38	45,82	103,14
6	ŠL	28	421	37,44	45,76	102,93
7	VJ	52	425	36,57	45,48	100,92
8	D	38	424	36,60	45,53	100,87
9	VJ	82	420	36,89	45,46	100,55
10	D	60	424	36,33	45,29	99,61
11	D	121	420	36,88	44,74	98,92
12	D	54	418	36,90	44,90	98,85
13	ŠL	35	420	37,17	43,73	97,08
14	VJ	82	421	36,70	43,86	96,71
15	ŠL	17	415	37,36	43,62	95,13
16	ŠL	10	414	37,29	43,16	95,08
17	VJ	55	419	36,43	43,56	94,84

[1)] VJ – Veliki jorkšir (Large White), ŠL – Švedski landras (Swedish Landrace), D – Durok (Duroc)

Of total of 17 boar-sires of pure breeds, 9 sires demonstrated effect on improvement of growth and quality of carcass sides in their offspring. Offspring of certain sires (sires 3,4, 5 and 6) were superior in all three traits to the average established for offspring of all studied boars. Others were above the average in two traits (boars 1,2,7 and 8). Boars 12 and 17 were bellow general average for all three traits in their offspring. Difference in total breeding value between the best and the worst boar was 10,41 index points (105,25 – 94,84=10,41).

If the total breeding value of boar is evaluated within the breed as the sum of breeding values calculated as deviation from the breed average, than they have the same rank within the breed (table 5).

Table 5. Total breeding value (UPV) of boars-sires within breed
Tabela 5. Ukupna priplodna vrednost (UPV) nerasta-očeva unutar rase

Švedski landras Swedish Landrace		Veliki jorkšir Large White		Durok Duroc	
Otac Sire	UPV I	Otac Sire	UPV I	Otac Sire	UPV I
2	104,10	1	105,89	3	104,30
4	102,88	5	103,76	8	100,96
6	102,64	7	101,52	10	99,70
13	97,13	9	101,15	11	99,02
15	96,20	14	97,31	12	98,96
16	94,74	17	95,43		

Table 6. Total breeding value (UPV) of boars-sires (Farm B)
Tabela 6. Ukupna priplodna vrednost (UPV) nerasta-očeva (Farma B)

Otac Sire	Rasa Breed	n	DPP (g) *LSM*	KMP (kg) *LSM*	MFO (kg) *LSM*	UPV *I*
μ ± S.E.			**373 ± 0,56**	**36,25 ± 0,07**	**42,38 ± 0,14**	
1	D	16	384	36,41	43,41	105,82
2	D	10	379	36,74	43,24	104,99
3	D	17	376	36,75	43,56	104,97
4	ŠL	22	372	36,61	43,24	102,75
5	D	44	369	36,55	43,56	102,54
6	ŠL	38	376	36,65	41,99	100,99
7	VJ	62	374	36,21	42,66	100,82
8	VJ	59	372	36,00	41,52	97,01
9	VJ	41	373	35,55	41,26	95,43
10	VJ	21	363	35,89	41,64	94,58

[1)] VJ – Veliki jorkšir (Large White), ŠL – Švedski landras (Swedish landrace), D – Durok (Duroc)

On farm B (table 6), offspring of Duroc sire had carcass of better quality and therefore boars of this breed were ranked high but difference

between them was only slight. Results showed that total breeding value of Large White boar was unsatisfactory. Of 4 boars 3 were bellow average, i.e. their total breeding value was lower than 100. Their offspring had less meat in warm carcass sides and lower total weight in «French» processed sides.

In performed investigations, fatteners had higher weight of warm carcass sides than in investigation reported by *Radović et al. (2003*), *Kosovac et al. (1998)* but not in study of *Pušić and Petrović* (*2004)*.

Content of meat in warm carcass sides of fatteners of different genotypes of 43,28 (farm A) and 43,91% (farm B) is higher than it was established by other authors in carcass sides of more than 80 kg of weight (*Latkovska, 1995-cit. Manojlović et al.,1999, Kosovac et al.,1998 and Pušić and Petrović,2004)*.

Obtained results on the significant effect of sire breed ($P<0,01$) on quantity and content of meat in warm carcass sides are in concordance with research results obtained by *Pušić and Petrović (2004)*.

In majority of mentioned researches the effect of the sex on variation of fattening and slaughter traits wasn't studied since authors stated that the sex ration was approximately the same or only one animals of one sex were investigated. *Kosovac et al. (1998)* established no statistically significant difference in carcass quality traits between female and castrated male animals. Results of present study are not in concordance with mentioned investigation since it was established that sex of fatteners had influence on variation of carcass quality traits. However, results are in concordance with researches of *Petrović et al. (2004)* and *Pušić and Petrović (2004)*.

Content of meat determined according to *Regulations (1985)* is lower by 8 to 12% compared to evaluation obtained when FOM is applied or dissection according to methodology recommended by EU. This means that objective quality of the fatteners' carcass is higher and could be in interval from 52 to 56%. The need for unification of carcass classification in our country according to EU regulations has been present for longer period. Researches carried out by *Bahelka et al. (2005)* show that application of new proposed formulas for evaluation of carcass quality on slaughter line using the two point method and measuring instruments enables the same evaluation of meat content in carcass as in dissection of four main carcass parts.

Results obtained in this investigation on significant influence of sires on variability of carcass quality traits of their offspring in both pig herds are in concordance with results of Petrović *et al. (2002), Radović et al. (*2003), *Kosovac et al. (1998) and Mijatović et al. (2005). Bahelka et al.*

(2004) established in one but not in the other test station that boars with better individual traits had produced offspring superior to offspring originating from not so good boars (+ 2,34% meat). Differences between groups of female half relatives of the best and the worst boar was 0,70 % meat, as established by Radović *et al. (2003)*.

Results of performed research show that difference between groups of half relatives of the best and the worst boar sire of breeds ŠL, VJ and D (farm A) was: +1,12, +1,62 and +1,57% meat in warm carcass sides. Differences between offspring of the best and the worst boar on the farm B for breeds VJ and D were smaller (+0,74 and +0,46% meat). Difference in total breeding value- UPV between the best and the worst boar on the farm A was 10,41 and on farm B 11,24 index points.

In order to improve the traits of carcass quality it is necessary to make selection of superior boar sires within the breed in order to increase the economical efficiency in pig production.

Conclusion

Results of the investigation of the effect of sire, sire and sex on quality of carcass sides showed that sire genotype had influenced ($P<0,01$) variation of all investigated traits of offspring on farm B. However, on farm A, sire genotype had no effect ($P>0,05$) on variation of daily gain of carcass sides, total weight and share of leg+shoulder+loin. Other investigated traits (DSL+DSK, KMP and SMP) varied ($P<0,01$) between boar genotypes. Also, sires had effect on variation on traits of their offspring. Statistically significant variation between females and barrows wasn't registered only in trait DPP ($P>0,05$).

Difference in total breeding value- UPV between the best and the worst boar on farm A was 10,41 and on farm B 11,24 index points.

UTICAJ RASE, OCA I POLA NA KVALITET POLUTKI SVINJA

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Rezime

Ispitivanje uticaja genetskih i negenetskih faktora (genotip oca, otac i pol) na osobine kvaliteta polutki, obavljeno je u 1443 tovljenika koji

su vodili poreklo od 5 genotipova očeva. Tovljenici su proizvedeni na dve farme svinja (farma A i B).

Dobijeni podaci su obradjeni metodom najmanjih kvadrata (*Harvey,*1990).

Prosečna masa toplih polutki tovljenika sa farme A i B je bila 85,78 i 82,59 kg. Genotip očeva uticao je (P<0,01) na variranje svih ispitivanih osobina potomaka na farmi B. Medjutim, na farmi A genotip očeva nije uticao (P>0,05) na variranje dnevnog prirasta toplih polutki, ukupnu masu i udeo francuske obrade polutki. Ostale ispitivane osobine (DSL+DSK, KMP i SMP) su varirale (P<0,01) izmedju genotipova nerasta. Takodje, očevi su uticali na variranje osobina svojih potomaka. Nisu ustanovljena statistički značajna variranja samo osobine DPP izmedju ženskih i muških kastriranih grla (P>0,05). Sve osobine kvaliteta trupa zavisile su od mase toplih polutki (P<0,01).

Razlika UPV izmedju najboljeg i najlošijeg nerasta na farmi A je bila 10,41 a na farmi B je bila 11,24 indeksnih poena.

Ključne reči: svinja, kvalitet polutki, rasa, otac, pol, priplodna vrednost.

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