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THE INFLUENCE OF BOAR BREED AND APPLIED METHOD ON THE MEAT CONTENT

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Abstract: The aim of this study was to determine the influence of the applied method of the quality carcass in 201 descendants, both sexes (n=108 male castrated animals and n=93 females), of studied boar-sires. For the determination of the meat yield (JUS1) and the share of meat (JUS 2) in carcass sides, on the basis of the performed measurements, tables for meat pigs, which are an integral part of the Rulebook on the quality of slaughtered pigs and categorization of pork meat (OG SFRY, 1985), were used. Share of meat (EC 94 and EC 06) was determined on cooled left carcass sides by method of partial dissection (according to methodology recommended by EU- Walstra and Merkus, 1996). Research was carried out on pig farm and in experimental slaughterhouse of the Institute for Animal Husbandry, Belgrade-Zemun. Housing, care and nutrition of animals were in accordance to breeding technology in investigated herd. The average share of meat determined by the application of the Rulebook (JUS2) was 43.58% with a lower absolute variation compared to the EU regulation from 1994 (EC 94; 53.56%) and from 2006 (EC 06; 56.55%). The estimated lean meat content by the application of the Rulebook (JUS 2) was by 9.98% lower compared to the EC 94 regulation and by 12.97% lower compared to EC 06. If we are talking about the selection of offspring for breeding, if we consider only the estimated leanness, we see that within the Landrace (L) breed we have high and very significant ($P<0.001$) differences between the sires for the assessed meat content according to EC 94 and EC 06. By implementing new methods of assessment of lean meat content (EC 94 and EC 06), a higher share of meat (9.98% respectively 12.97%) was determined compared to the Rulebook (1985). This research indicates the necessity of changing the current method for the establishment of meat content of pigs in the Republic of Serbia.

Key words: boar, sire, sex, season, qualification of pig carcases

Introduction

The most important factors determining the carcass quality are genetic and environmental factors. The quantitative and qualitative properties of the carcass depend on the selection methods. By cross-breeding of pigs a heterosis effect is achieved for major productive properties. Finding the best combinations of crosses is a continuous process, since the frequency of certain genes continuously changes by the selection (*Senčić et al., 2003*). It is known that certain quantitative properties of pigs are unevenly inherited, which means that the possibilities for their improvement in selection are different. The pig genotype, in addition to the nutrition, has the greatest effect on carcass quality and meatiness. The prerequisite for work on the genetic improvement of pig quality is knowledge of the variability of the production properties of the breeding animals. Regardless of the significance of the evaluation of the carcass quality and meat quality on the slaughter line, there is a problem in our country that in most slaughterhouses (except for some) no automatic or semi-automatic devices for their assessment are used. For more than 20 years the economic environment in the country has been too dynamic and insecure, which has put domestic pig breeding in difficult situations. In the process of joining the European Union, Serbia must implement the qualification of pig carcases under the (S)EUROP system. This system is obligatory for each member of EU (*Zapryanova, 2019*). In our country, the Rulebook (*OG SFRY, 1985*), according to which the total mass of muscular tissue without the belly-rib meat is determined, is still applicable. Due to the above, the content of meat determined according to the Rulebook (*OG SFRY, 1985*) is lower by 8 to 12% compared to evaluation using FOM or dissection according to the methodology recommended by the EU (*Walstra and Merkus, 1996*). Given the fact that total dissection of the carcass side is expensive and complicated, the EU has recommended a short procedure. According to this procedure, the left carcass side is cut into 12 parts, and only on 4 parts (leg, shoulder, back-loin and belly-rib part) the total dissection is performed. In the research of *Radović et al. (2009)***,** the difference in the values for share of meat established according to the Rulebook (*OG SFRY, 1985*) and dissection (according to the method recommended by the EU) was 8.83% for the genotype Large White (LW) and 10.02% for the genotype Swedish Landrace (SL).

Material and Methods

Research was carried out on pig farm and in experimental slaughterhouse of the Institute for Animal Husbandry, Belgrade-Zemun. Housing, care and nutrition of animals were in accordance to breeding technology in investigated herd. The quality of the carcass was tested in 201 descendants, both sexes (n=108 male castrated animals and n=93 females), of studied boar-sires. For the

determination of the meat yield (JUS 1) and the share of meat (JUS 2) in carcass sides, on the basis of the performed measurements, tables for meat pigs, which are an integral part of the Rulebook on the quality of slaughtered pigs and categorization of pork meat (*OG SFRY, 1985*), were used. Share of meat (EC 94 and EC 06) was determined on cooled left carcass sides by method of partial dissection (according to methodology recommended by EU-*Walstra and Merkus, 1996*). Left carcass sides were cut into 12 parts (Figure 1).

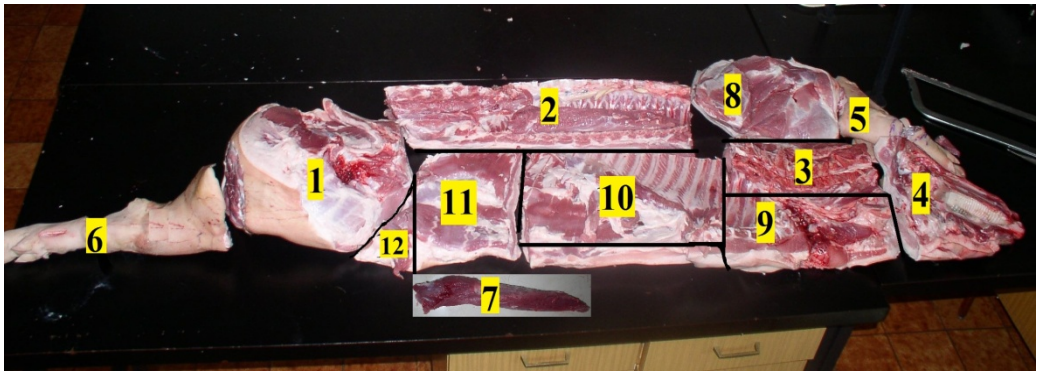

Figure 1. Scheme for cutting of carcass side into 12 parts
(Photo: Č. Radović)

Based on quantity of meat in four major parts – leg, shoulder, loin-rump and belly-rib part (skin with subcutaneous tissue, intermuscular fat and bones), which contain 75% of total musculature mass of carcass side, and mass of tender loin, percentage of meat in carcass sides was calculated using two formulas/equations:

1. Commission Regulation EC No 3127/94 (EC 94)

$$y = 1.3 \times 100 \times \frac{\text{weight of tender loin} + \text{weight of lean (fascia included) in shoulder, loin, ham and belly}}{\text{weight of tender loin} + \text{weight of dissected cuts} + \text{weight of remaining cuts}}$$

2. Commission regulation EC No 1197/06 (EC 06)

$$y = 0.89 \times 100 \times \frac{\text{weight of tender loin} + \text{weight of lean (fascia included) in shoulder, loin, ham and belly}}{\text{weight of tender loin} + \text{weight of dissected cuts}}$$

Data processing was carried out using the appropriate computer package "LSMLMW and MIXMDL, PC-2 VERSION" (*Harvey, 1990*), using the procedure of the least squares method in order to determine the significance (P<0.05) of the systematic effects on the growth traits, the quality of the carcass sides and meat. Properties of carcass quality were analysed by using models (1 and 2) that included the following factors: sire's race, sire, sex, offspring birth season and linear influence of warm carcass side weight.

$$Y_{ijklm} = \mu + R_i + O_{j:i} + P_k + P_{k:i} + S_l + b_3 (x_3 - \bar{x}_3) + \varepsilon_{ijklm}$$

Results and Discussion

Table 1 shows the average values for meat yield and share (JUS 1 and JUS 2) as well as the share of meat obtained using the forms of *EC No 3127/94* and *EC No 1197/06* regulations for the assessment of lean meat content. The average share of meat determined by the application of the Rulebook (JUS2) was 43.58% with a lower absolute variation compared to the EU regulation from 1994 (EC 94; 53.56%) and from 2006 (EC 06; 56.55%). The estimated lean meat content by the application of the Rulebook (JUS 2) was by 9.98% lower compared to the EC 94 regulation and by 12.97% lower compared to EC 06.

Table 1. Average values and variability of yield traits and meat share in the carcass side

Trait		$\bar{x}$ ± SD
JUS 1	Meat yield in carcass sides (*OG SFRY 1985*), kg	35.36 ± 4.33
JUS 2	Meat yield in carcass sides (*OG SFRY 1985*), %	43.58 ± 1.66
EC 94	Meat yield in carcass sides (*EC No 3127/94*), %	53.56 ± 4.48
EC 06	Meat yield in carcass sides (*EC No 1197/06*), %	56.55 ± 4.50

The effect of the sire breed, sires within breed, sex and season on the variation of meat content in carcass sides assessed under the Regulation (JUS2) and two EU Regulations (*EC 94 and EC 06*) is shown in Table 2. The general average for meat share in carcass sides determined by application the aforementioned methods was 43.62, 55.18 and 58.07%, respectively.

Quality of pig carcasses, i.e. the presence of muscle and fatty tissue, depends on the sex (*Renaudeau et al., 2005; Renaudeau and Mourot, 2007; Serrano et al., 2007; Radović et al., 2008, Carabús et al., 2017*), which was also found in our studies of fat thickness, yield and meat share. According to Wagner et al. (1999), male and female animals had almost the same share of fat tissue with 25 kg (6.92 and 7.00%), but with 100 kg it was higher in boars (16.33%) than in gilts (13.92 %). This difference between the sexes increased at a weight of 152 kg, so the share of belly fat tissue in males was 20.00 and in the gilts 16.91%. The results

of our research on the effect of sex on the quality of pig carcasses are in agreement with the results of *Latorre et al. (2003, 2004)* and *Radović et al. (2008)*. On the basis of a total dissection of four carcass parts, estimated leanness [Commission Regulation EC No 3127/94, (1994)] of genotypes 1 (SL), 6 [Px (SLxLW)], 8 [SLx (SLxLW)] and 9 [LWx (SLxLW)] in our trials was higher (+ 10.88%, + 6.66%, + 4.56% and + 5.10%) than shown by *Kosovac et al. (2009a)* for the same genotypes.

Table 2. The effect of sire breed and sires within the breed on yield traits and meat share in carcass sides (LS Mean ±S.E.)

Sources of variation		JUS 1[2)], kg	JUS 2, %	EC 94, %	EC 06, %
μ ± S.E.		35.41 ±0.20	43.62 ±0.18	55.18 ± 0.44	58.07 ± 0.45
RO[1)]	sire				
Landrace	1	35.72 ± 0.42	44.19 ± 0.39	52.82 ± 0.95	55.45 ± 0.97
	2	36.31 ± 0.45	44.87 ± 0.42	54.85 ± 1.01	57.89 ± 1.04
	3	35.52 ± 0.46	43.84 ± 0.42	50.33 ± 1.02	53.94 ± 1.05
	7	35.34 ± 0.57	43.42 ± 0.53	57.70 ± 1.28	61.21 ± 1.31
	8	34.48 ± 0.54	43.12 ± 0.50	57.93 ± 1.21	60.76 ± 1.25
	9	35.25 ± 0.58	43.85 ± 0.54	58.53 ± 1.30	62.26 ± 1.34
	15	36.14 ± 0.54	44.24 ± 0.50	53.46 ± 1.19	56.78 ± 1.23
	16	35.91 ± 0.52	44.27 ± 0.48	55.20 ± 1.15	58.72 ± 1.18
	17	36.22 ± 0.50	44.84 ± 0.46	58.16 ± 1.12	61.58 ± 1.15
	18	36.66 ± 0.48	44.33 ± 0.44	55.29 ± 1.06	58.63 ± 1.09
	Average	35.75 ± 0.24	44.10 ± 0.22	55.43 ± 0.54	58.72 ± 0.55
Large White	4	34.94 ± 0.46	43.66 ± 0.43	52.63 ± 1.03	55.53 ± 1.06
	5	32.78 ± 0.46	41.17 ± 0.43	46.14 ± 1.03	49.06 ± 1.05
	6	34.33 ± 0.46	42.68 ± 0.42	51.13 ± 1.02	53.60 ± 1.04
	Average	34.02 ± 0.29	42.50 ± 0.27	49.97 ± 0.65	52.73 ± 0.66
Pietrain	14	36.49 ± 0.33	44.85 ± 0.31	56.32 ± 0.74	60.46 ± 0.76
	19	36.38 ± 0.61	44.25 ± 0.56	64.92 ± 1.35	65.78 ± 1.39
	20	36.51 ± 0.62	43.67 ± 0.57	59.17 ± 1.38	62.06 ± 1.42
	Average	36.46 ± 0.39	44.26 ±0.36	60.14 ±0.86	62.77 ±0.89
MTP (b)		0.357***[3)]	-0.006[NS]	-0.039[NS]	-0.068*

[1)]SB-sire breed; MTP (b) -linear effect of warm carcass side weight (MTP = 81.20 kg); [2)] JUS 1-yield of meat in carcass sides, JUS 2 - share of meat in carcass sides, EC 94 - share of meat in carcass sides, EC 06 - share of meat in carcass sides [3)] ***=P<0.001; *=P<0.05; NS=P>0.05

The highest yield (JUS 1) and the share of meat in the carcass sides (JUS 2, EC 94 and EC 06) were determined in offspring of sires of Pietrain breed (Table 2). In these animals, the largest difference in the estimation of lean meat between JUS2 and EC94 was found (difference was 15.88%) and between JUS 2 and EC 06 (the difference was 18.51%). In regard to the share of meat in the carcass side using the *Rulebook* (JUS 2), a smaller difference was found between offspring of

sires of P and L breeds (0.16%), and P and LW (1.76%). The offspring originated from the sires of Pietrain breed had 60.14% of the meat in carcass side determined by the application of Regulation EC 94. The determined mean value was by 10.17 and 4.71% higher than for the offspring of the LW and L sires, respectively. By using the equation for the calculation of the lean meat content using EC 06, it was established that the offspring of the sires of Pietrain breed had a higher share of meat than the offspring of L sires (4.05%) and LW sires (10.04%).

The variation of the meat content by the application of the Rulebook (JUS 2) between the sires of L and P breeds was low (from 43.12 to 44.87% and from 43.67 to 44.85%) and was not statistically significant (Table 2). Between the descendants of three LW boars, the variation in the lean meat content was greater (from 41.17 to 43.66%) and statistically very significant ($P<0.001$; Table 4). The highest estimated lean meat content with the application of EU regulations (EC 94 and 06), within the L breed, was established for sire No. 9 (58.53% and 62.26%), while the lowest in offspring of sire No. 3 (50.33 and 53.94%). The determined difference between the offspring of these sires amounts to 8.20% and 8.32% of the muscle tissue in the carcass sides. The lowest mean values of these traits were recorded in animals originating from sire No.5 of the LW breed (46.14 and 49.06%), while the highest values were determined for the offspring of sire No.19 of Pietrain breed (64.92 and 65.78%). The difference in mean values of the meat content in the carcass sides between the offspring of these two boars-sires was 18.78% (EC 94) and 16.72% (EC 06).

Female animals had higher values (Table 3) for yield and meat share in carcass sides compared to male castrated animals. The meat content of carcass sides in female animals was estimated to be by 1.18 (JUS2), 4.22 (EC 94) and 4.62% (EC 06) higher compared to male castrated animals. The differences were statistically significant at the level of 99.9% (Table 4). When we observe the season of birth we see that the animals born in the winter period had higher average values of meat content in carcass sides determined by using the EC 94 (57.45%) and EC 06 (61.07%) Regulations compared to animals born in other seasons.

The sire breed, sires within the LW breed and the sex/gender had a very high statistically significant influence ($P<0.001$) on the yield and share, i.e. the meat content of carcass sides (Table 4). Sires within the L breed showed no influence only on the lean meat content of the carcass sides determined by the application of the *Rulebook* (JUS2), while the other properties were influenced ($P<0.01$ and $P <0.001$).

Table 3. The effect of sex/gender, sex/gender within the sire breed and the year of birth (Model 1) on the yield traits and the share of meat in carcass sides (LS Mean ±S.E.)

Sources of variation		JUS 1[2)], kg		JUS 2, %		EC 94, %		EC 06, %	
Sex	M[1)]	34.94	± 0.22	43.03	± 0.21	53.07	± 0.50	55.98	± 0.51
	F	35.89	± 0.23	44.21	± 0.22	57.29	± 0.52	60.16	± 0.54
Season	Winter	35.94	± 0.65	44.53	± 0.61	57.45	± 1.46	61.07	± 1.50
	Spring	34.80	± 0.25	43.10	± 0.24	50.63	± 0.57	53.51	± 0.58
	Summer	35.67	± 0.31	43.56	± 0.28	55.78	± 0.68	58.38	± 0.70
	Autumn	35.23	± 0.28	43.28	± 0.26	56.85	± 0.62	59.33	± 0.64

[1)]M-male castrates, F-females; [2)] JUS 1- yield of meat in carcass sides, JUS 2 – share of meat in carcass sides, EC 94 - share of meat in carcass sides, EC 06 - share of meat in carcass sides

The yield traits and the share of meat in the carcass sides, determined by the application of the *Rulebook* (JUS1 and JUS2), did not vary between the sires of Pietrain breed and the season of birth (P> 0.05). However, the estimated values for leanness obtained by applying the EC 94 and EC 06 regulations varied between the boars – sires of Pietrain breed (P<0.001). The interaction between the sex within the sire race for JUS 1 and JUS 2 was statistically significant (P <0.001), but in case of share of meat in carcass sides according to EC94 and EC06 it was not significant (P>0.05).

Table 4. Statistical significance of the influences included in the model on the tested properties

Sources of variation	JUS 1[2)]	JUS 2	EC 94	EC 06
SB	***[3)]	***	***	***
S:L	**	NS	***	***
S:LW	***	***	***	***
S:P	NS	NS	***	***
Sex	***	***	***	***
Season	NS	NS	***	***
Sex:SB	***	***	NS	NS

[1)]SB-sire breed; S:L-sires within Landrace breed; S:LW- sires within Large White breed; S:P- sires within Pietrain breed; Sex:SB- sex of offspring within sire breed; [2)] JUS 1- yield of meat in carcass sides, JUS 2- share of meat in carcass sides, EC 94 - share of meat in carcass sides, EC 06 - share of meat in carcass sides; [3)] ***=P<0.001; **=P<0.01; NS=P>0.05

By comparing the two regulations EC94 and EC06, the average estimated meat content of the tested fatteners in our trials was 53.56% and 56.55%, which means that the difference between them is 2.99% of the meat. The established difference in the average estimated meat content by applying the above regulations is lower (4.13%) than results presented by *Kosovac et al. (2009b)*. For hybrid combinations of crosses with three [(LWxL) xJ and (LxD) xJ] and four breeds

[(LWxL) x (JxP) and (LWxL) x (HxP)], *Bahelka et al. (2005)*, for both sexes (f = 61 animals and m = 62 animals), assessed the average meat content [*Commission Regulation EC No 3127/94, (1994)*] on the basis of a total dissection of four carcass parts of 55.54%, which is by 1.98% higher value compared to our result (53.56%).

Conclusions

In general, on the basis of the previously mentioned, as well as the results in their entirety, it can be concluded that it is of the utmost importance that the sires are evaluated on the slaughter line both for the production of fattening animals and for future breeding animals, since the share of heritability (h^2) for traits of carcass quality is very high. When we talk about the production of fatteners, the best results were achieved by offspring originated from the sires of Pietrain breed. If we are talking about the selection of offspring for breeding, if we consider only the estimated leanness, we see that within the L breed we have high and very significant ($P<0.001$) differences between the sires for the assessed meat content according to EC94 and EC06. By implementing new methods of assessment of lean meat content (EC 94 and EC 06), a higher share of meat (9.98% respectively 12.97%) was determined compared to the Rulebook (1985). This research indicates the necessity of changing the current method for the establishment of meat content of pigs in the Republic of Serbia.

Uticaj rase nerasta i primenjene metode na sadržaj mesa

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Rezime

Cilj ove studije bio je da se utvrdi uticaj primenjene metode kvaliteta trupa kod 201 potomka, oba pola (n = 108 kastriranih mukih grla i n = 93 ženskih), ispitivanih očeva nerastova. Za određivanje prinosa mesa (JUS1) i udela mesa (JUS 2) u polutkama, na osnovu izvršenih merenja, korićene su tabele za mesnate svinje, koji su sastavni deo Pravilnika o kvalitetu zaklanih svinja i kategorizaciji svinjskog mesa (SG SFRJ, 1985). Udeo mesa (EC 94 i EC 06) određen je na ohlađenim levim polutkama metodom delimične sekcije (prema metodologiji preporučenoj od strane EU - Walstra i Merkus, 1996). Istraživanje je sprovedeno na svinjarskoj farmi i u eksperimentalnoj klanici Instituta za stočarstvo Beograd-Zemun. Smeštaj,

nega i ishrana životinja bili su u skladu sa tehnologijom uzgoja u ispitivanom zapatu.
Prosečan udeo mesa utvrđen primenom Pravilnika (JUS2) iznosio je 43,58% sa nižom apsolutnom varijacijom u poređenju sa uredbom EU iz 1994. (EC 94; 53,56%) i iz 2006 (EC 06; 56,55%). Procenjeni sadržaj mesa primenom Pravilnika (JUS 2) bio je za 9,98% niži u odnosu na uredbu EC 94 i za 12,97% niži u odnosu na EC 06. Ako govorimo o izboru potomstva za uzgoj, ako uzmemo u obzir samo procenjenu mesnatost, vidimo da unutar rase L imamo visoke i veoma značajne (P <0,001) razlike između očeva za procenjeni sadržaj mesa u skladu sa EC 94 i EC 06. Implementacijom novih metoda procene sadržaja mesa (EC 94 i EC 06), utvrđen je veći udeo mesa (9,98%, odnosno 12,97%) u poređenju sa Pravilnikom (1985). Ovo istraživanje ukazuje na neophodnost promene postojeće metode utvrđivanja sadržaja mesa svinja u Republici Srbiji.

Ključne reči: nerast, otac, pol, sezona, kategorizacija svinjskih trupova

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