SEASONAL AND YEAR DYNAMICS IN THE QUALITY CHARACTERISTICS IN PIG CARCASSES

Jivko Nakev[1], Teodora Popova[2], Maya Ignatova[2], Penka Marinova[2], Tania Nikolova[1]

[1]Agrcultural Institute, 9700 Shumen, Bulgaria
[2]Institute of Animal Science, 2232 Kostinbrod, Bulgaria
Corresponding author: Jivko Nakev, jivko_nakev@abv.bg
Original scientific paper

Abstract: The aim of our study was to assess the dynamics of the characteristics in pig carcasses as affected by the season and year of slaughter. A total of 106 027 carcasses of growing-finishing pigs of commercial production, slaughtered in the same abattoir in 2014 and 2015 were included in the study. The carcasses were classified using UltraFOM 200 device, as the characteristics controlled were back-fat thickness at two locations and the depth of *m. Longissimus dorsi*. These measurements were used to further determine the lean meat percentage. The results of the study showed significant differences in the dynamics of changes of carcass characteristics during the seasons and the years. The highest lean meat percentage was found in summer (56.48%), followed by spring (56.34%), autumn (56.29%) and winter (56.10%). On the other hand, the pigs slaughtered in winter displayed highest carcass weight and back-fat thickness at both locations.

Keywords: pigs, carcass characteristics, lean meat, back-fat, seasons, year

Introduction

The systems for classification and payments of pigs for slaughter play an important role for the intensifying of the process of improvement of the carcass characteristics. The development and implementation of SEUROP system affects considerably the qualities of the finishing pigs in the countries where it is being applied (*Kalm*, 1998; *Čandek-Potokar et al*., 2004; *Pulkrábek et al*., 2006; *Castryck*, 2007).
According to *Savescu and Laba* (2016) the accurate work of the system is a basis for a fair payment to the pig producers and in order to ensure the its efficient work, the monitoring of the results obtained as well as eliminating of the negative impacts on its accuracy are of critical importance. In this regard the influence of some factors such as the sex of the animals (*Engel and Walstra*, 1993; *Gispert and Diestre*, 1994; *Daumas and Dhorne*, 1996; *Choi and Lee*, 2001; *Radović et al.,*

2012; Knecht and Duziński, 2016), their weight (*Correa et al*., 2006; *Vítek et al*., 2012), genotype (*Vítek et al.,* 2009; *Gogić et al. 2014; Zhang et al*., 2015), carcass presentation (*Pulkrábek et al*., 2010) or season of finishing and slaughter (*Piwczyński et al*., 2013) has been thoroughly investigated.

The aim of our study was to assess the dynamics of the carcass characteristics in pigs as affected by the year and season of slaughter.

Material and methods

The study included 106 027 growing-finishing pigs of commercial production, slaughtered in the same abattoir in 2014 and 2015. The quality characteristics of the carcasses were determined according to the Regulation 15/8.05.2009. The classification was done using Ultra FOM 200 device. The traits controlled included:

X_1- thickness of back-fat with skin, measured at 7 cm from the carcass midline between 3d and 4th last lumbar vertebra (mm);

X_2- thickness of the back-fat with skin, measured at 7 cm from the carcass midline between 3d and 4th last rib (mm);

X_3- depth of *m. Longissimus dorsi* (m. LD), measured at X_2 (mm).

The weight of the carcasses was recorded up to 45 min *post mortem* 0.01 kg.

For the purposes of the study the experimental material was divided by months as follows: I - III (winter), IV-VI (spring), VII-IX (summer), and X-XII (autumn).

The carcass data were subjected to two-way ANOVA. The model included the fixed effects of year, season and their interaction. The means were further compared through Tukey post-hoc test. The statistical evaluation was performed by JMP v.13 software package.

Results and discussion

Figure 1 presents the data of the number of the studied carcasses. It can be seen that in 2014 a total of 43052 pigs were slaughtered, while in the next year their number was 63675.
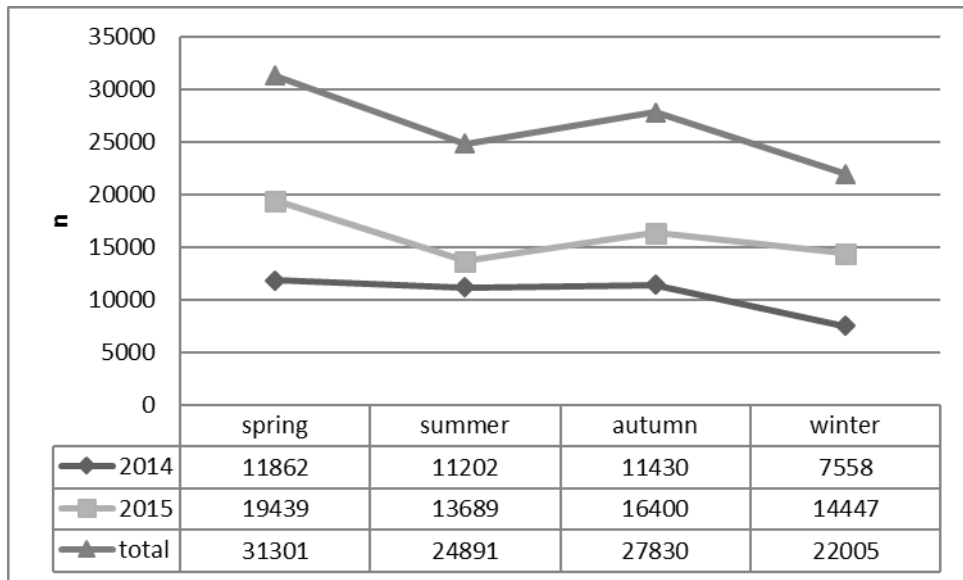
Figure 1. Number of carcasses studies in during the seasons in 2014 and 2015

The percentage of classified carcasses was the highest in spring-33 301 pigs (29.52%), followed by the autumn – 27 830 pigs (26.25%), summer – 24 891 pigs (23.48%) and winter – 22 005 pigs (20.75%). The difference in the number of the studied pigs during both years were determined by the increase of the work load of the abattoir and also by the changes of the share of meat import in the total mass of processed pork.

The average lean meat percent (LMP) was 56.34%, and the carcass weight of the pigs was 85.00 kg (Table 1).

Table 1. Mean, standard deviation (SD), coefficient of variation (CV), minimum and maximum values of the lean meat percentage, carcass weight, back-fat thickness and depth of m. LD

Item	LMP, %	Carcass weight, kg	Back-fat X_1, mm	Back-fat X_2, mm	m. LD X_3, mm
Mean	56.34	85.13	18.59	15.14	58.28
SD	1.85	8.44	3.61	3.18	8.89
CV, %	3.28	9.91	19.43	21.01	15.25
Minimum	36.6	49	7	7	7
Maximum	63.1	132.01	47	51	92

In a previous study with 100 762 pigs, carried out in 2009 (*Nakev*, 2010), the determined lean meat percentage was 56.72%, whereas the carcass weight was 76.80 kg. *Marinova et al.* (2008) reported that the carcass weight of pigs,

slaughtered in three Bulgarian districts (Razgrad, Turgovishte and Plovdiv) in the period 2006-2007 was 81.64 kg. The study included 1 865 scalded carcasses. The highest variability in the analysed traits was observed in regard to the back-fat (19.43% - 21.01%) depending on the location of the measurement. The variation coefficients of carcass weight and depth of m. LD were 9.88% and 15.25% respectively. The deviations for LMP did not exceed 3.3 %.

The results of ANOVA showed that besides the significant effect of the year and season of slaughter, both factors interacted significantly (Table 2).

Table 2. ANOVA results for the effect of year, season and their interaction on the carcass traits

Source	LMP			
	df	MS	F	Sig.
Year	1	960.69	285.35	***
Season	3	531.45	157.45	***
Interaction	3	415.02	123.27	***
Error	106020			
	Carcass weight			
	df	MS	F	Sig.
Year	1	119323.69	1745.49	***
Season	3	23854	348.94	***
Interaction	3	17693.44	258.82	***
Error	106020			
	Back-fat X1			
	df	MS	F	Sig.
Year	1	9515.68	752.03	***
Season	3	2595.77	205.14	***
Interaction	3	5113.59	404.13	***
Error	106020			
	Back-fat X2			
	df	MS	F	Sig.
Year	1	104.18	10.39	**
Season	3	1122.95	111.45	***
Interaction	3	341.58	33.90	***
Error	106020			
	Depth of m. LD X3			
	df	MS	F	Sig.
Year	1	8786.83	113.08	***
Season	3	22757.96	292.89	***
Interaction	3	12809.82	164.86	***
Error	106020			

** $P<0.01$; *** $P<0.001$

Figure 2 shows the changes of the lean meat percentage in the pig carcasses according to the year and season of slaughter. During 2014 the pigs slaughtered in

summer had the highest values of LMP, as there were significant differences between this season and the others.
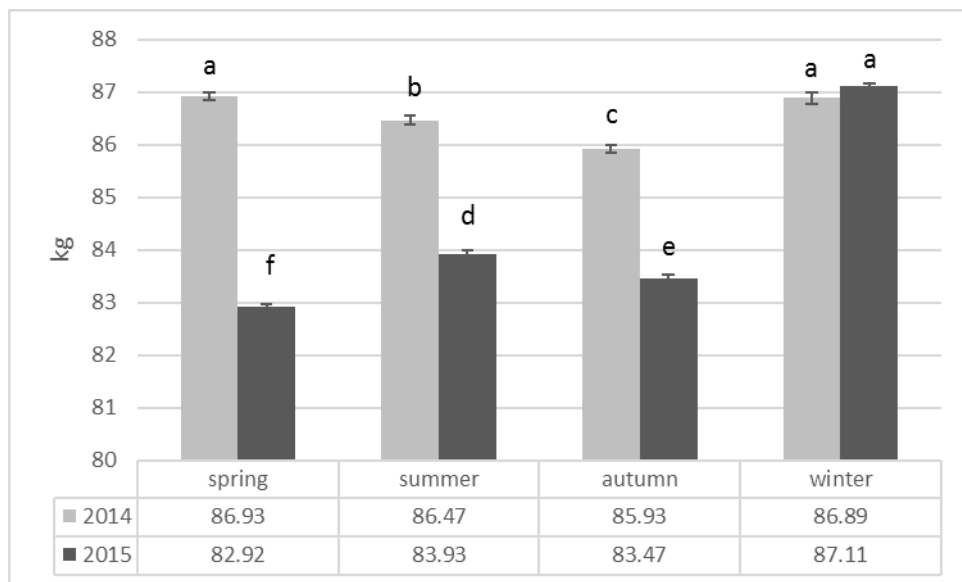

	spring	summer	autumn	winter
▪ 2014	56.09	56.43	56.16	56.16
▪ 2015	56.6	56.23	56.43	56.06
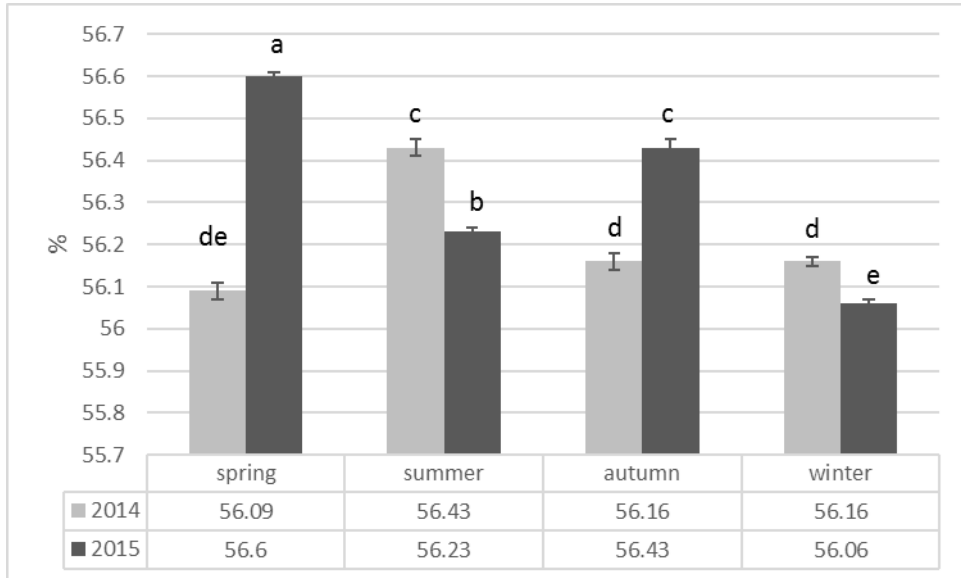
Different letters connecting seasons mean statistical difference (P<0.05)

Figure 2. Dynamics of change in the lean meat percentage (LMP) during the seasons in 2014 and 2015

For the rest three seasons there were no differences in the lean meat content and it varied in the range of 56.09-56.16%. In contrast, in 2015 the four seasons differed in regard to the lean meat percentage of the carcasses, as the highest was observed in the pigs slaughtered in spring, followed by those slaughtered in autumn. In the winter of 2015 the carcasses of the slaughtered animals displayed the lowest lean meat percent when compared to the other seasons of the year. Within the seasons, the lean meat content also differed between the years of slaughter, however the trend of change in this characteristic was opposite, which reflects the significant interaction between the factors year and season displayed in Table 2. Similar to us, Piwczyński et al. (2013) found that the lowest lean meat percentage of pig carcasses was recorded in winter (55.06%). However the authors reported also lowest percentage of the lean meat in summer (55.39%) while highest in autumn (55.01%).

The weight of the carcasses (Fig. 3) was significantly higher in the animals slaughtered in 2014, when compared to 2015 in all the seasons except in winter. In 2014 the values of this trait decreased from spring to autumn, after that increase was found in winter.
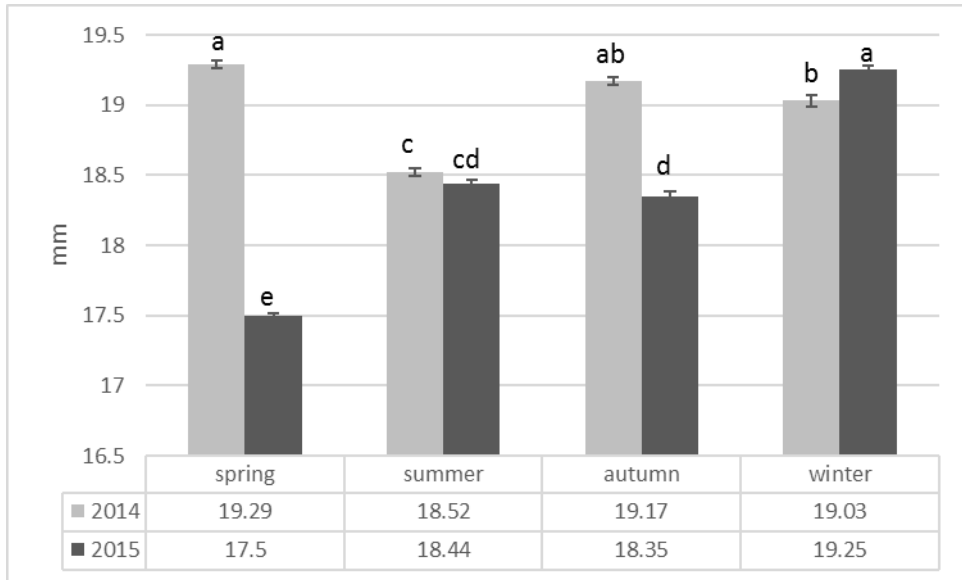
Different letters connecting seasons mean statistical difference (P<0.05)

Figure 3. Dynamics of change in the carcass weight during the seasons in 2014 and 2015

Similarly, in 2015, the pigs slaughtered in winter displayed high weight, however there was considerable difference between the winter season and the rest of the seasons in this year, as such was not observed to this extent in 2014. It could be seen that the seasonal dynamics in the carcass weight during the two years corresponded to the lean meat percentage, as the high carcass weight found in spring 2014 and the winter season of the two years corresponded to the lower lean meat percent.

The highest values of back-fat thickness X1 (Fig. 4) were measured in the pigs slaughtered in the spring of 2014 and winter of 2015.
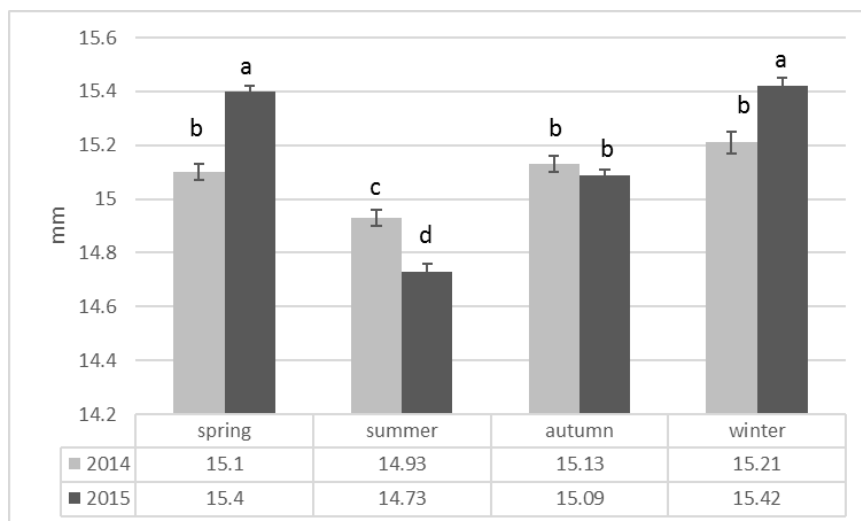
	spring	summer	autumn	winter
■ 2014	19.29	18.52	19.17	19.03
■ 2015	17.5	18.44	18.35	19.25

Different letters connecting seasons mean statistical difference (P<0.05)

Figure 4. Dynamics of change in the back-fat thickness (X1) during the seasons in 2014 and 2015

During 2014 the back-fat thickness decreased significantly in summer, increased in autumn and then diminished slightly in winter. Opposite changes were observed in the next year, when the pigs slaughtered in spring displayed lowest values of X1. In autumn, X1 was reduced, and then raised in winter. Except this season, as was found for the carcass weight, the values of X1 remained lower in 2015, compared to 2014, particularly in spring and autumn, when the discrepancies were statistically significant.

Decrease in the back-fat thickness X2 (Fig. 5) was observed in the summer of 2014, however the values of this parameter increased in autumn and winter, when they reached maximum. Similar tendency of change in X2 according to the season was recorded in 2015. In regard to the year of slaughter, significantly higher values of X2 was measured in the pigs slaughtered in spring and winter of 2015, in comparison to 2014.

Different letters connecting seasons mean statistical difference (P<0.05)
Figure 5. Dynamics of change in the back-fat thickness (X2) during the seasons in 2014 and 2015

The dynamics of change in the depth of m. LD (X3) showed constant increase in the animals slaughtered in spring, summer and autumn of 2014, when they reached maximum and consequently decreased (Fig 6).
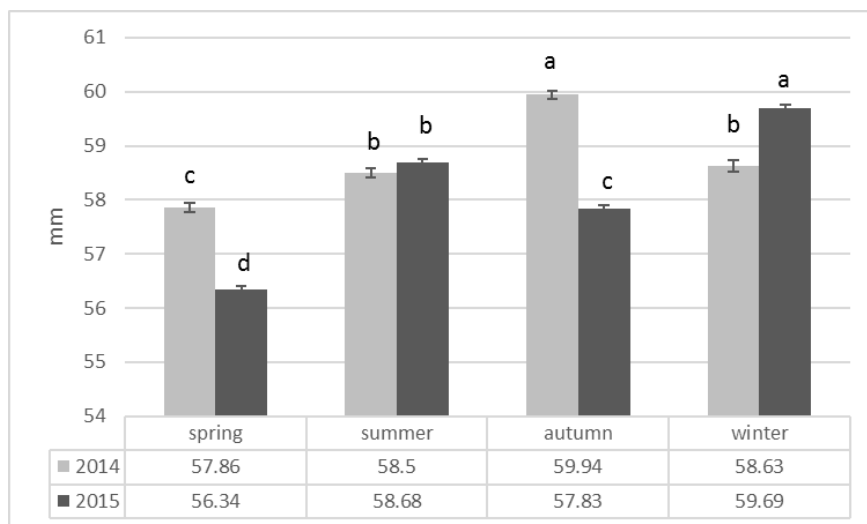
Different letters connecting seasons mean statistical difference (P<0.05)
Figure 6. Dynamics of change in the depth of m. LD (X3) during the seasons in 2014 and 2015

In 2015, the pigs were characterized by the lowest depth of m. LD in spring and the highest in winter. In the spring and autumn, the pigs slaughtered in 2014 had higher muscle depth, while in winter the values of this parameter were significantly higher in the animals slaughtered in 2015. The analysis of data showed that the changes of X2 were opposite to those in the depth of m. LD in the same location as this was observed only in the carcasses studied in 2015. Despite the different trends of the changes in the back-fat thickness in the two years, the present study showed seasonal variations in the values of this trait in the different anatomical locations. This is agreement with results of *Salces et al*. (2006), *Škorput et al*. (2009), *Chmielowiec-Korzeniowska et al.* (2012), *Piwczyński et al.* (2013). According to *Trezona et al.* (2004), the seasonal variations in the back-fat thickness were mostly associated to the carcass weight. In our study, the carcass weight recorded in spring and winter corresponded to the back-fat thickness X1 and X2 in 2014, whereas the variation in the back-fat in the two anatomical locations in summer and autumn were opposite to the trends of changes in the carcass weight. In 2015 the changes in the carcass weight were respective to those of X1.

In addition to the carcass weight, other factors more or less related to the seasons might explain the variation in the carcass characteristics of the pigs. One of them is the ambient temperature, since it is known that the pigs are very sensitive towards this factor (*Fagundes et al.,* 2009; *Lehatoyová et al*., 2012). According to *Massabie et al*. (1997), high temperatures suppress the appetite of the pigs and hence lead to lower feed intake. This could explain the lower values of the back-fat thickness in summer, observed for X1 in 2014 and X2 in both studied years. Results of *Lefaucheur et al.* (1991) also prove that the ambient temperature might dramatically affect the characteristics of the muscle and adipose tissue and lead to protein loss which is associated with negative changes in the productive performance and carcass quality in pigs.

On the other hand, *Škorput et al*. (2009), suggested that the differences in the back-fat thickness during the seasons might be due to the production conditions as well as genotype variations. As stated by *Trezona et al.* (2004), the production conditions and particularly the stocking density and the stress might considerably contribute to the carcass quality variations. According to these authors, the above mentioned factors might lead to reduction in the back-fat thickness due to reduced feed intake, as well to inhibit protein deposition due to increased protein catabolism (*Chapple et al*., 1993).

Conclusions

The present study showed significant differences in the dynamics of changes in the carcass characteristics as affected by the season and year of slaughter. The highest lean meat percentage was recorded in the animals slaughtered in summer (56.48%),

followed by those slaughtered in spring (56.34%), autumn (56.29%) and winter (56.10%). The pigs slaughtered in winter had the highest carcass weight and back-fat thickness X_1 and X_2.

Sezonska dinamika osobina kvaliteta svinjskih trupova

Jivko Nakev, Teodora Popova, Maya Ignatova, Penka Marinova, Tania Nikolova

Rezime

Cilj našeg istraživanja je bio da se proceni dinamika osobina kvaliteta svinjskih trupova pod uticajem sezone i godine klanja. Ukupno 106.027 trupova tovnih svinja za komercijalnu proizvodnju, zaklanih u istoj klanici u toku 2014. i 2015. godine je bilo uključeno u istraživanje. Trupovi su klasifikovani upotrebom UltraFOM 200 uređaja, a osobine kontrolisane u ovom istraživanju su: debljina leđne slanine na dve lokacije i dubina *m. longissimus dorsi*. Ove mere su dodatno korišćene za određivanje mesnatosti. Rezultati istraživanja su pokazali značajne razlike u dinamici promena osobina trupa tokom godišnjih doba i godina klanja. Najveći procenat mesnatosti je pronađena u leto (56,48%), zatim proleće (56,34%), jesen (56,29%) i zimu (56,10%). S druge strane, svinje zaklane u zimskom periodu su pokazale najveće mase trupova i debljine leđne masti na obe lokacije.

References

ČANDEK-POTOKAR M., KOVAČ M., MALOVRH Š. (2004): Slovenian experience in pig carcass classification according to SEUROP during the years 1996 to 2004. Journal of Central European Agriculture, 4, 323-330.
CASTRYCK F. (2007): The Belgian pig production and health policy. EPP Congress. Ghent. Available at: httm/www.pigproducer.net/uploads/media/castytryck.pdf
CHAPPLE R.P. (1993): Effect of stocking arrangement on pig performance. In: Batterham E.S. (ed.) "Manipulating pig production IV". Australasian Pig Science Association, Victoria, 87-97.
CHMIELOWIEC-KORZENIOWSKA A., TYMCZYNA L., BABICZ M. (2012): Assessment of selected parameters of biochemistry, hematology, immunology and production of pigs fattened in different seasons. Archiv Tierzucht 55, 5, 469-479.

CHOI C. S., LEE J. G. (2001): Investigation of breed, sex and environmental factors of swine economic traits on-farm test records. Journal of Animal Science and Technology, 4, 431-444.

CORREA J. A., FAUCITANO L., LAFOREST J.P., RIVEST J., MARCOUX M., GARIÉPY C. (2006): Effects of slaughter weight on carcass composition and meat quality in pigs of two different growth rates. Meat Science,72, 1, 91-99.

DAUMAS G., DHORNE T. (1996): Historique et futur du classement objectif des carcasses de porc en France. Journées Rech Porcine en France, 28, 171-180.

ENGEL B., WALSTRA P. (1993): Accounting for subpopulations in prediction of the proportion of lean meat of pig carcasses. Animal Production, 1, 147-152.

FAGUNDES A. C. A., da SILVA R.G., GOMES J.D.F., SOUZA L.W.O., FUKUSHIMA R. S. (2009): Influence of environmental temperature, dietary energy level and sex on performance and carcass characteristics of pigs. Brazilian Journal of Veterinary Research and Animal Science, 46, 1, 32-39.

GISPERT M., DIESTRE A. (1994): Classement des carcasses de porc en Espagne; in pas vers l'harmonisation communautaire. Techniporc, 2, 29-32.

GOGIĆ M., PETROVIĆ M., RADOVIĆ Č., ŽIVKOVIĆ B., RADOJKOVIĆ D., STANIŠIĆ N., SAVIĆ R. (2014): Variation of traits of fatteners under the impact of various factors. Biotechnology in Animal Husbandry, 30, 4, 687-697.

JMP, Version 13. SAS Institute Inc., Cary, NC, 1989-2007.

KALM E. (1998): Marktgerecht Schweine produzieren heisst mit System produzieren. Landwirtsch. Bl. Weser – Ems, 19, 20-27.

KNECHT D., DUZIŃSKI K. (2016): The effect of sex, carcass mass, back fat thickness and lean meat content on pork ham and loin characteristics, Archives Animal Breeding, 59, 51-57.

LEFAUCHEUR L., LE DIVIDICH J., MOUROT J., MONIN G., ECOLAN P., KRAUSS D. (1991): Influence of environmental temperature on growth, muscle and adipose tissue metabolism, and meat quality of swine. Journal of Animal Science, 69, 2844-2854.

LEHOTAYOVÁ A., BUČKO O., PETRÁK J., MRÁZOVÁ J., DEBRECÉNI O., 2012. Effect of high ambient temperature on meat quality of pigs. Research in Pig Breeding, 6, 2, 37-40.

MARINOVA P., POPOVA T., VASILEVA V. (2008): Level of some prediction traits for determination of lean meat percentage in the carcasses of pigs reared in Bulgaria. Journal of Animal Science (BG), 3, 173-177.

MASSABIE P., GRANIER L., LE DIVIDICH J. (1997): Effects of environmental conditions on the performance of growing-finishing pigs. 5. International symposium, Bloomington, USA, In: Livestock environment V", 2, 1010-1016.

NAKEV J. (2010): Quality profile of pig carcasses. Journal of Animal Science (BG), 5, 39-42.

PIWCZYŃSKI D., WOCHNA P., KOLENDA M., CZAJKOWSKA A. (2013): The effect of slaughtering season on the carcass quality of growing finishing pigs. Polish Journal of Natural Science, 28, 4, 437–448.

PULKRABEK J., PAVLEK J., VALIŠ L., VITEK M. (2006): Pig carcass quality in relation to carcass lean meat proportion. Czech Journal of Animal Science 51, 18-23.

PULKRÁBEK J., DAVID L., VÍTEK M., VALIŠ. L. (2010): Pig carcass presentation with flare fat in Czech republic. Research in pig breeding, 4, 2, 13-16.

SALCES A. J., SEO K.S., CHO K.H., KIM S.D., LEE Y.C. (2006): Genetic parameter estimation of carcass traits of Duroc predicted using ultrasound scanning modes. Asian-Australasian Journal of Animal Science, 19, 10, 1379 – 1383.

RADOVIĆ Č., PETROVIĆ M., ŽIVKOVIĆ B., RADOJKOVIĆ D., PARUNOVIĆ N., STANIŠIĆ N., GOGIĆ M. (2012): The effect of different fixed factors on carcass quality three breed fattening pigs. Biotechnology in Animal Husbandry, 28, 4, 779-786.

REGULATION 15 of Ministry of agriculture and food from 8th of May, 2009. SG, № 37 / 19th of May, 2009.

SAVESCU R., LABA M. (2016): Multivariate regression analysis applied to the calibration of equipment used in pig meat classification in Romania. Meat Science, 116, 16–25.

ŠKORPUT D., VINCEK D., LUKOVIĆ Z. (2009): Fixed effects in models for the genetic evaluation of back-fat thickness and time on test in gilts Italian Journal of Animal Science, 8 (suppl.3), 119-121. TREZONA, M., MULLAN, B. P., D'ANTONIO M., WILSON R. H., WILLIAMS I. H. (2004): The causes of seasonal variation in back-fat thickness of pigs in Western Austria. Australian Journal of Agricultural Research, 55, 273-277.

VÍTEK M., VALIŠ L., PULKRÁBEK J., DAVID L. (2009): Carcass value and meat quality in pig final hybrids. Research in pig breeding, 3, 1, 63-66.

VÍTEK M., DAVID L., VALIŠ L., PULKRABEK J. (2012): The effect of sex, weight and lean meat content on the pig carcass realization. Research in pig breeding, 6, 2, 97-101.

ZHANG S.-H., SHEN L. –Y., LUO J., WU Z.-H., JIANG Y.-Z., TANG G.-Q., LI M.-Z., BAI L., LI X.-W., ZHU. L. (2015): Analysis of carcass and meat quality traits and nutritional values of hybrid wild boars under different crossing systems. Genetics and Molecular Research, 14, 1, 2608-2616.