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THE EFFECT OF SLAUGHTERING SEASON ON THE CARCASS QUALITY OF GROWING FINISHING PIGS

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K e y w o r d s: growing-finishing pigs, seasonality, lean meat percentage, carcass quality.

A b s t r a c t

The study included 83823 growing-finishing pigs of the commercial production, which were slaughtered in commercial meat factory in 2010 and 2011. The aim of the study was to assess the impact of the year and season, in which the slaughtering took place, on the carcass and meat quality traits. After slaughtering some traits were controlled using the ultrasound device Ultra Fom 300: the backfat thickness and the height of *musculus longissimus dorsi* in two points. These four measurements were used to determine the lean meat percentage and consequently the classification of carcasses according to the EUROP system. The analysis of variance showed a statistical effect of the year, season and interactions between them on all analysed features. It was shown that pigs with the highest values for lean meat percentage were obtained in autumn (55.39%) and with the lowest values were obtained in summer (55.01%) and winter (55.06%). The decline in the number of pigs slaughtered in 2011 could result from the increased share of imported meat in the total mass of processed pork.

WPŁYW SEZONU UBOJU NA JAKOŚĆ TUSZY TUCZNIKÓW

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S ł o w a k l u c z o w e: tuczniki, sezonowość, mięsność, jakość tuszy.

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Abstrakt

Badaniami objęto 83 823 tuczniki populacji masowej dostarczane do jednego z zakładu przetwórstwa mięsnego w latach 2010–2011. Zasadniczym celem badań była ocena wpływu roku oraz pory roku, w których odbywały się uboje, na cechy przydatności rzeźnej. Po uboju tuczników za pomocą urządzenia ultradźwiękowego Ultra Fom 300 kontrolowano: grubość słoniny wraz ze skórą i wysokość mięśnia najdłuższego grzbietu w dwóch punktach. Wymienione cztery pomiary wykorzystano do określenia mięsności, a w konsekwencji do sklasyfikowania tusz wg systemu EUROP. W analizie wariancji wykazano statystyczny wpływ roku, pory roku i interakcji tych czynników na wszystkie analizowane cechy. Dowiedziono, że na ogół tuczniki o najwyższej mięsności były pozyskiwane jesienią (55,39%), zaś najniższej – latem (55,01%) i zimą (55,06%). Zaobserwowany spadek liczby ubijanych tuczników w roku 2011 mógł być efektem wzrostu udziału importowanych tusz / mięsa w ogólnej masie przetwarzanej wieprzowiny.

Introduction

Poland is one of Europe's leading producers of pigs. Traditionally, pork is the main source of meat for Polish households. The production and supply of pigs in Poland are characterized by significant periodic fluctuations, which result from the profitability that is changing cyclically. Unfortunately, the tendency of declining the number of pigs in recent years has been noted (KNECHT and ŚRÓDOŃ 2011). By ensuring that the slaughter material supplied to commercial meat factory is of a high quality, it is possible to change the profitability, and therefore, reverse the downward trend in the pig population.

In Poland, the remuneration that the supplier of the slaughtering material provided for the commercial production receives depends on the body weight of slaughtered animals and lean meat percentage – the ratio of weighed lean meat versus the weight of the pig carcass (LMP). It the European Union countries the LMP is used for classifying pig carcasses (Commission Regulation – no. 3127/1994, NISSEN et al. 2006, VESTER-CHRISTIANSEN et al. 2008). LMP is determined based on a multiple regression equation, which includes four explanatory variables: backfat thickness and the height of the *musculus longissimus dorsi* at two points: 7 cm from the midline of the carcass at the last ribs and 7 cm. Between LMP and the above-mentioned explanatory (independent) variables the moderate and high dependence was found by SZYNDELER-NĘDZA and ECKERT (2008).

The diversity of carcass and meat quality, including lean meat percentage, depends of various factors such as body weight, sex and breed (BABICZ et al. 2008, SLÁDEK et al. 2004, NOWACHOWICZ 2004, SZYNDELER-NĘDZA and ECKERT 2008). In previous studies, the authors (PIWCZYŃSKI et al. 2010) have shown that the size of livestock suppliers (the production scale) affects the quality of the material. According to BABICZ et al. (2008) and MICHALSKA et al. (2006) the carcass and meat quality may varied according to the year of slaughter.

ANTOSIK et al. (2010) and RODRIGUEZ-SÁNCHEZ et al. (2009) noted that the level of the slaughter characteristics may also vary due to time of year.

The aim of this study was to assess the impact of the year and the season on the carcass and meat characteristics of growing-finishing pigs of both sexes, from a commercial production, delivered to commercial meat factory in the years 2010–2011. In addition, the aim was to examine the relationship between the carcass weight, lean meat percentage and selected measurements of backfat and *longissimus dorsi* muscle.

Materials and Methods

The animal material consisted of 83823 growing-finishing pigs of both sexes from Kujawy and Pomorze voivodship, slaughtered in the years 2010–2011 in commercial meat factory. After slaughtering growing-finishing pigs were classified with the use of ultrasound device Ultra Fom 300 according to the EUROP system (S, E, U, R, O, P) (Commission Regulation no. 1249/2008, Commission Implementing Decision... 2011/506/UE; Rozporządzenie MRiRW Dz.U. nr 28, poz. 181). Previously, the thickness of backfat (Backfat) and the height of the *musculus longissimus dorsi* (MLD) at two points: 7 cm from the midline of the carcase at the last ribs (Backfat 1, MLD 1) and 7 cm from the midline of the carcase between the third and fourth last ribs (Backfat 2, MLD 2), were determined. These four measurements allowed to determine the lean meat percentage (LMP) (Commission Regulation no. 3127/1994).

By using a two-way analysis of variance, the authors evaluated the effect of year (2010 and 2011) and season (spring – III, IV, V, summer – VI, VII, VIII, autumn – IX, X, XI, winter – XI, I, II) on: carcass weight, lean meat percentage, backfat thickness and *longissimus dorsi* muscle. The significance of differences between compared groups (year and season), was analyzed by means of Scheffe test (SAS Institute, 2011). The χ^2 test of independence, that was used subsequently, allowed to determine the type of relationship between the year and season, during which slaughtering were carried out, and the results of EUROP classification. Moreover, the Pearson correlation coefficient between carcass weight, backfat thickness, height of MLD and LMP was calculated. Statistical analyses were performed by using the SAS statistical package (SAS Institute Inc. 2011).

Results and Discussion

Out of 83823 growing-finishing pigs, 43099 were slaughtered in 2010, and 40724 in the following year. Presumably, the decreasing number of slaugh-

tered animals results from the decreased production profitability. The number of slaughtered animals per month, depending on the year of slaughtering, ranged as follows: in 2010 – 2467–4795 individuals, in 2011 – 2681–3924 individuals (Figure 1). In 2010 most animals were slaughtered between December and January, i.e. during the period of Christmas and New Year. The least animals were slaughtered during the peak of the holiday period in July and August. A similar trend was not observed in the following year, since the peak of slaughter fell on August and November and the decrease on May and June.

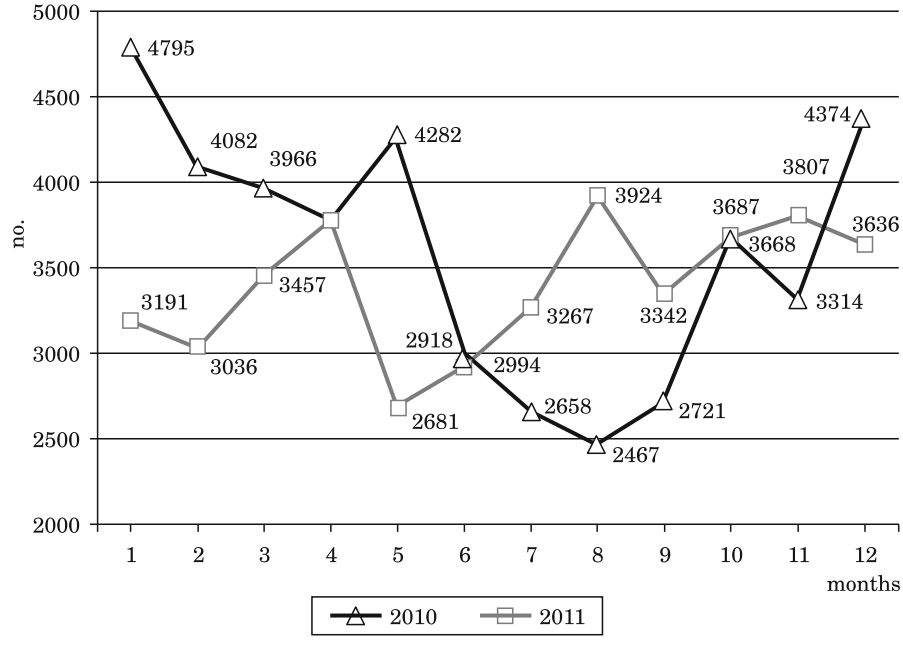


Fig. 1. The number of growing-finishing pigs slaughtered in the following months of 2010 and 2011

The average carcass weight of slaughtered pigs was 86.28 kg and the average lean meat percentage (LMP) was 55.17% (Table 1). The result of LMP was better than the one reported by BABICZ et al. (2008) in the study conducted in years 2005–2006, on 530 thousand growing-finishing pigs from the region of Lublin Voivodeship, since their result was 50.86–51.45%. The present result was also better than the one noted by KNECHT and ŚRÓDOŃ (2011) for the domestic population of pigs slaughtered in 2010 (54.8%). Moreover, similar or higher LMP values than those obtained in the present studies were obtained by ANTOSIK et al. (2010) – 57.96% and SIECZKOWSKA et al. (2009) – 57.46%.

However, it should be noted that those studies were carried out on the considerably smaller number of animals, and were additionally racially diverse.

Table 1

Descriptive characteristics of the studied traits

	Carcass weight [kg]	MLD 1 [mm]	MLD 2 [mm]	Backfat 1 [mm]	Backfat 2 [mm]	LMP [%]
Mean	86.28	57.34	54.96	15.06	17.10	55.17
Standard deviation	10.93	6.17	6.91	4.45	5.09	3.75
Coefficient of variation [%]	12.66	10.75	12.57	29.54	29.77	6.80
Lower quartile	78.60	53.10	50.10	11.80	13.40	53.00
Median	85.90	57.60	55.20	14.40	16.50	55.60
Upper quartile	93.40	61.80	60.00	17.60	20.00	57.80

Explantions: MLD 1 – height of *musculus longissimus dorsi* 1; MLD 2 – height of *musculus longissimus dorsi* 2; Backfat 1 – backfat thickness 1; Backfat 2 – backfat thickness; LMP – lean meat percentage.

The analysis of the designated quartiles indicates that, in terms of weight, 25% of the carcases did not exceed 78.6 kg, following 25% was in the range from 78.6 to 85.9 kg, and further 25% was in the range from 85.9 to 93.4 kg (Table 1). The remaining 25% of the carcasses was characterized by a weight higher than 93.4 kg. It was noted that the highest variability among the analyzed features characterized the backfat thickness – the coefficient of variation, depending on the point of measurement, ranged from 29.54% to 29.77%. The variability of carcass weight and the MLD height did not exceed 13%. The greatest equalization was observed in case of LMP index, 6.8%.

The analysis of variance showed a highly significant ($P < 0.0001$) effect of year, season (Table 2) and interaction (Figure 2) of both factors on all examined traits. It should be emphasized that the differences between the year 2010 and 2011, in all examined traits, were considered highly significant also according to the Scheffe test. The analysis of the calculated arithmetic means shows that in 2011, in comparison to 2010, slaughtered growing-finishing pigs had a lower carcass weight, height of MLD and backfat thickness. The lean meat percentage (LMP) of animals slaughtered in 2011 was 55.32% and was by 0.3 percentage units higher than those slaughtered in 2010.

Table 2

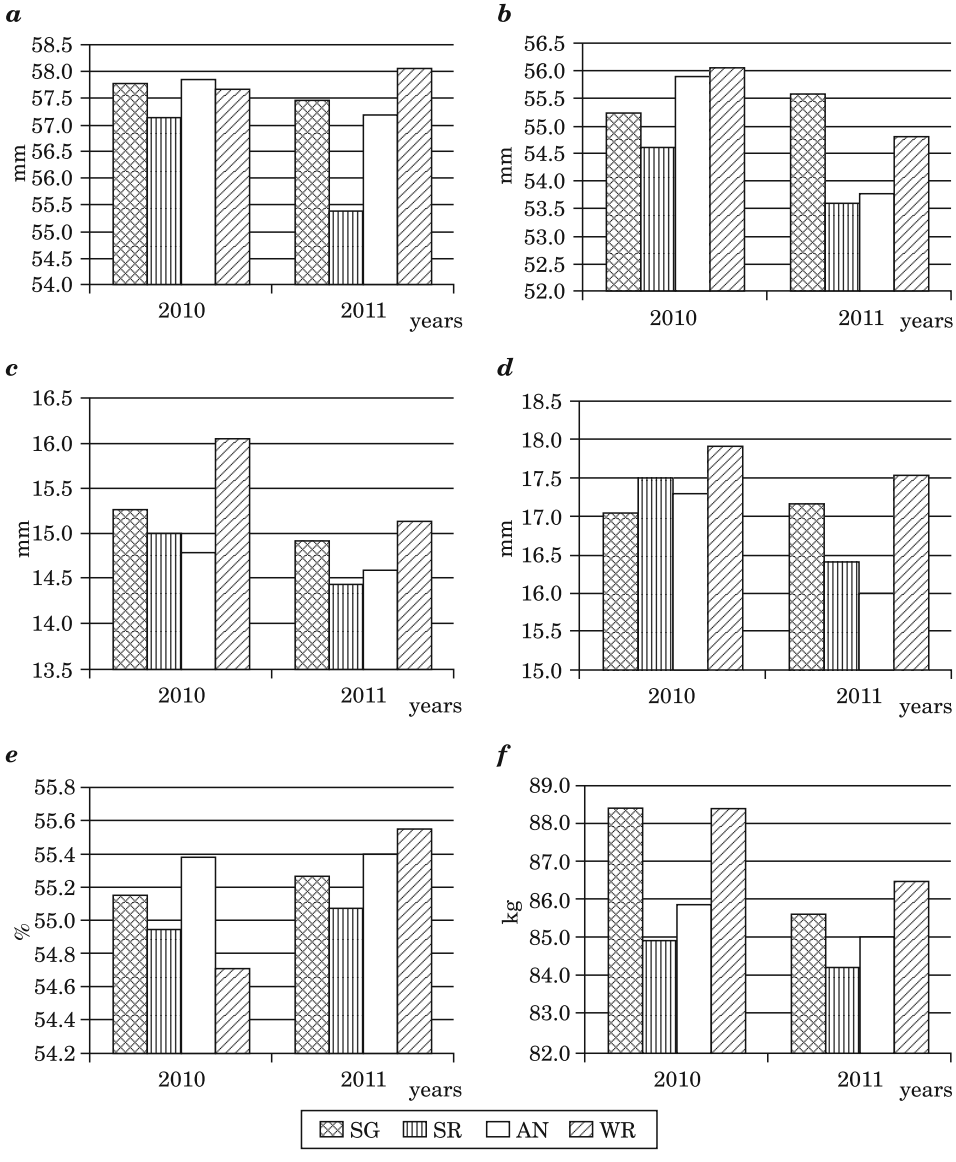
Influence of the year and slaughter season on analysed traits

Trait	Statistic	Year		Season of the year			
		2010	2011	spring	summer	autumn	winter
Carcass weight [kg]	$\bar{x}$	87.16 A	85.32 A	87.12 A	84.53 AB	85.43 ABC	87.58 ABC
	CV	12.34	13.03	12.29	13.13	12.77	12.49
MLD 1 [mm]	$\bar{x}$	57.64 A	57.02 A	57.64 Aa	56.17 AB	57.5 Bb	57.83 Bab
	CV	10.36	11.14	10.48	11.07	10.9	10.43
MLD 2 [mm]	$\bar{x}$	55.5 A	54.39 A	55.39 A	54.02 AB	54.75 ABC	55.49 BC
	CV	12.23	12.86	12.7	12.74	12.52	12.19
Backfat 1 [mm]	$\bar{x}$	15.35 A	14.76 A	15.11 A	14.69 AB	14.68 AC	15.66 ABC
	CV	28.96	30.06	29.99	30.41	28.77	28.69
Backfat 2 [mm]	$\bar{x}$	17.44 A	16.74 A	17.07 A	16.88 AB	16.62 ABC	17.73 ABC
	CV	29.3	30.15	30.17	30.64	29.38	28.7
LMP [%]	$\bar{x}$	55.02 A	55.32 A	55.2 A	55.01 AB	55.39 ABC	55.06 AC
	CV	7	6.69	6.94	6.95	6.45	7.04

Explanations: AA (aa) – averages marked with the same capital (small) letters, vary at $P \leq 0.01$ ($P \leq 0.05$); CV – coefficient of variation, MLD 1 – height of *musculus longissimus dorsi* 1; MLD 2 – height of *musculus longissimus dorsi* 2; Backfat 1 – backfat thickness 1; Backfat 2 – backfat thickness; LMP – lean meat percentage

BABICZ et al. (2008) indicate that year of the slaughter may differentiate the slaughter material. The difference between LMP of pigs slaughtered in two years i.e. 2005 and 2006, was 0.59 percentage units ($P \leq 0.01$). Moreover, the carcass weight increased by 0.4 kg ($P < 0.05$). According to MICHALSKA et al. (2006), changes in carcass and meat quality observed over time may be caused by the successful breeding program. In Poland the effects of genetic improvement in gilts herds, having a direct mass population, are presented in the annual reports of the Polish Pig Breeders and Producers Association „POLSUS" (2012).

By analyzing the impact of the seasons on the investigated traits, it was found that growing-finishing pigs slaughtered during winter and spring had the highest carcass weight, height of MLD and backfat thickness, which was found to be highly significant (Table 2). In turn, growing-finishing pigs that had been slaughtered in summer had the lowest carcass weight and MLD



Interactions – $P < 0.0001$

Fig. 2. Slaughter traits in respect of the year of research and season: *a* – height of *musculus longissimus dorsi* 1; *b* – height of *musculus longissimus dorsi* 2; *c* – backfat thickness 1; *d* – backfat thickness 2, *e* – lean meat percentage, *f* – carcass weight

height. The animals slaughtered in autumn had the thinnest backfat. The carcass lean meat percentage (LMP), depending on the time of year ranged in a narrow interval, from 55.01% to 55.39%. The highest value of these traits characterized the carcasses of pigs slaughtered in autumn, while the lowest characterized the carcasses of pigs slaughtered in spring.

In the present studies, the results of the impact of the seasons on the value of the carcass and meat quality are in accordance with the study of ANTOSIK et al. (2010), which was conducted on 2500 growing-finishing pigs of the commercial production. Pigs slaughtered during autumn were characterized by the highest meat content, the greatest height of MLD and the lowest backfat thickness at the S1 point.

The distribution of carcass classes, depending on the year and season, is presented in the Table 3. The chi-square test showed a highly significant relationships ($P \leq 0.01$) between the year, season of year and carcass classification according to EUROP system. The impact of both factors, i.e. year and season, on lean meat percentage, which is the basis for the classification of carcasses according to the EUROP system, was previously demonstrated by means of analysis of variance (Table 2). The results presented in the table confirmed a better LMP of animals slaughtered in 2011, compared to those slaughtered in 2010 – a greater share of carcasses was classified as a class S and E. At the same time, the distributions showed that, generally, the greatest number of carcasses was classified to the S and E class during autumn and

Table 3
The distribution of lean meat percentage classes in respect of the year of research and season

Factor	Level		Lean meat percentage class						Total
			–	S	E	U	R	O	P	
Year	2010	N	3438	20216	15245	3592	573	35	43099
		%	7.98	46.91	35.37	8.33	1.33	0.08	
	2011	N	3338	20618	13364	2917	436	51	40724
		%	8.2	50.63	32.82	7.16	1.07	0.13	
Season of the year	spring	N	1950	10505	7463	1718	269	37	21942
		%	8.89	47.88	34.01	7.83	1.23	0.17	
	summer	N	1227	8955	6379	1423	221	23	18228
		%	6.73	49.13	35	7.81	1.21	0.13	
	autumn	N	1685	10393	6947	1329	177	8	20539
		%	8.2	50.6	33.82	6.47	0.86	0.04	
	winter	N	1914	10981	7820	2039	342	18	23114
		%	8.28	47.51	33.83	8.82	1.48	0.08	
Total	–	N	6776	40834	28609	6509	1009	86	83823
		%	8.08	48.71	34.13	7.77	1.20	0.10	

spring: 58.80% and 56.77% respectively (Table 3). Among the evaluated carcasses 90.93% were classified as class SEU, which indicated a good quality of carcass and meat.

SLÁDEK et al. (2004) reported positive correlations between the slaughter weight and the MLD height (r = 0.327) and backfat thickness (r = 0.450). The negative relationships were observed between backfat thickness and the meat content in carcasses (r = 0.907). Consequently, when the warm carcass weight increased, the backfat thickness and height of MLD increased as well (ANTOSIK and KOĆWIN-PODSIADŁA 2010).

All correlation coefficients, calculated during the present studies and placed in Table 4, despite a wide range of values, were highly significant. Most of them indicated positive relationships. The negative relations were noted between backfat thickness in two points and measurement of MLD and LMP, as well as between carcass weight and LMP. It was observed that carcass weight was weakly (r = 0.083–0.179) correlated with the height of MLD and low (point 2, r = 0.367) and moderate (point 1, r = 0.424) correlated with the backfat thickness, and low (r = -0,250) correlated with meat content (Table 4). The correlation coefficients indicate moderate (0.597–0.609) relationship between the height of MLD and LMP. High (–0.872) and very high values (–0.903) of correlation coefficients were obtained for the association between backfat thickness in two points and LMP. These results are in accordance with those reported by SZYNDLER-NĘDZA and ECKERT (2008) in terms of the direction of the relationship between measurements of backfat thickness and MLD (results of performance tested gilts) and LMP. In the cited studies the

Table 4

The relationship between tested traits

Traits	Carcass weight	MLD 1	MLD 2	Backfat 1	Backfat 2
MLD 1 [mm]	0.179 <.0001	–	–	–	–
MLD 2 [mm]	0.083 <.0001	0.438 <.0001	–	–	–
Backfat 1 [mm]	0.424 <.0001	-0.338 <.0001	-0.322 <.0001	–	–
Backfat 2 [mm]	0.367 <.0009	-0.260 <.0001	-0.440 <.0001	0.829 <.0001	–
LMP [%]	-0.250 <.0001	0.597 <.0001	0.609 <.0001	-0.903 <.0001	-0.872 <.0001

Explanations: MLD 1 – height of *musculus longissimus dorsi* 1; MLD 2 – height of *musculus longissimus dorsi* 2; Backfat 1 – backfat thickness 1; Backfat 2 – backfat thickness; LMP – lean meat percentage

discrepancies occurred in the strength of relationships. The correlation coefficients between the backfat thickness in two points and lean meat percentage LMP ranged from –0.753 to –0.628. On the other hand, in the case of the height of MLD, measured in point 2, the correlation coefficient was significantly lower – 0,066–0,170.

The analysis of variance showed that the interaction between year and season was highly significant in all analyzed traits. Therefore, arithmetic means for each seasons, depending on the year of slaughter, were additionally analyzed in detail (Figure 2). The analysis showed that in 2010 carcasses of the highest weight were collected during the autumn and winter season, and the lowest during spring and summer. The same trend continued in later years, however, the differences in the average carcass weight in corresponding seasons were significantly lower. The results obtained in the present studies, as well as those obtained by other authors (SLHDEK et al. 2004, SZYNDLER-NĘDZA and ECKERT 2008), demonstrated a statistical correlation between the carcass weight and the ultrasound measurements and carcass lean meat percentage. Therefore, it may be expected that in the seasons in which slaughtered animals had the highest weight, the backfat thickness in two points would be the greatest. It was fully confirmed in the case of the both thickness measurement points, but only in relation to the year 2011 (Figure 2). In 2010, the backfat thickness, measured in the point 2, was the highest during the winter months, and the thinnest during spring.

Taking into account the height of MLD, measured at both points, it was found that the height was the smallest in spring – both in 2010 and 2011. However, it was not possible to clearly identify which season resulted in achieving the maximum height of MLD, as it was additionally conditioned by the year of slaughter. It was noted that in 2010, LMP was the highest during the autumn period, and the lowest in winter. A year later, the previous ranking was different, the growing-finishing pigs slaughtered during winter had the highest meat content, and those slaughtered during summer had the lowest.

Conclusions

The present study showed a highly significant effect of the year and season on the carcass weight and the slaughter quality of growing-finishing pigs. Growing-finishing pigs, that were slaughtered during autumn, were found to have the highest lean meat percentage (55,39%), while those slaughtered during summer (55,01%) and winter (55,06%) were found to have lower LMP. At the same time highly significant interactions indicated that the effect of seasons on the slaughter characteristics was modified by the year of slaughter.

The findings indicate high monthly and annual fluctuations in the number of slaughtered animals, which most likely was caused by changing economic situation. The statistical analysis of correlations revealed that the carcass weight was moderately, positively correlated with the backfat thickness in two points, and negatively correlated with the lean meat percentage of carcasses.

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