Acta Agraria Kaposváriensis (2010) Vol 14 No 2, 245-250
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Influence of pig carcass weight on distribution of tissues in main parts

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ABSTRACT

The present study was performed on 241 swine carcasses were divided into 3 weight groups according to the warm carcass weight (light group: 60–80 kg; medium group 80–100 kg and heavy group 100–120 kg). Using the measures of backfat and muscle thickness lean meat percentage of pig carcasses was predicted by the equation for TP method prescribed in Croatia. After 24 hours of cooling, right sides of the carcasses were dissected according to EU referent method into four main parts (ham, shoulder, loin and ribs) and further into major tissues (muscle, subcutaneous fat with skin, intermuscular fat and bones). Obtained data was statistically analysed and differences between the weight groups were established for the carcass traits and tissue composition of the main parts. It was concluded that although significant differences existed in backfat and muscle thickness between the pig carcass weight groups, lean percentage predicted or established by dissection these carcasses was not significantly altered. Moreover, the percentages of tissues dissected from the main parts rarely differed significantly between the weight groups of carcasses. This is especially important for the percentage of muscle tissue in the main parts which increased only in ham. As a general conclusion it can be stated that increasing pig carcass weight does not necessarily have to impair other carcass traits or tissue distribution in the main parts.
(Keywords: pigs, carcass weight, dissection, carcass composition, main parts)

INTRODUCTION

Beside the age, genotype, sex, feeding regime and other sources of variance, it is well known that carcass traits can differ between the pigs regarding the slaughter weight (*Cisneros et al.,* 1996; *Candek-Potokar et al.,* 1997; *Correa et al.,* 2006). Data collected from Croatian slaughterhouses in past ten years show trend of increasing the slaughter weight, from 99.14 kg in 1999 up to 104,59 kg in 2008 (*Annual report of Croatian Agricultural Agency,* 2008). During that time, similarly to some other countries, the lean percentages in the carcasses of slaughtered pigs also increased resulting in heavier carcasses (*Bahelka et al.,* 2005; *Kušec et al.,* 2009). In fact, *Correa et al.* (2006) suggested that pigs can be slaughtered at heavier weights without compromising carcass quality. However, some pig producers tend to slaughter their pigs at lower live weights in the belief that they will achieve higher scores of carcass grading. In this light, the objective of present paper is to investigate the effect of hot carcass weight on the distribution of main tissues in the joints after thorough dissection according to EU reference method (*Walstra and Merkus,* 1996).

MATERIALS AND METHODS

This study was performed on 241 swine carcasses selected on the basis of backfat measures obtained by "TP" method, approved in Croatia and slaughtered in slaughterhouses across Croatia during several dissection trials in past 4 years. On the basis of carcass weight the carcasses were divided into 3 weight groups as follows; light group weighted between 60 to 80 kg, medium group 80 to 100 kg and heavy group was between 100 and 120 kg. Before dissection, necessary measures for lean percentage prediction by "two points" (TP) method were obtained as follows: lumbar muscle thickness – Mdt (mm); measured as the shortest connection between the cranial end of the lumbar muscle and dorsal edge of the vertebral canal, and fat thickness – Sdt (mm), measured as the minimum thickness of subcutaneous fat (with skin) at the split of the carcass, above *m. gluteus medius*. Using these measures lean percentage of pig carcasses was predicted by the equation prescribed for TP method in Croatian legislation (NN 40/2007). One day after the slaughter, right sides of the carcasses were dissected according to EU referent method (*Walstra and Merkus,* 1995). Four main parts (ham, shoulder, loin and ribs) were dissected into muscles, bones, intramuscular and subcutaneous fat with skin and weighted. The reference lean percentage was expressed as prescribed by valid EU regulation (EC No. 1197/2006). The data were analysed using STATISTICA (data analysis software system), version 8.0 (*StatSoft, Inc.,* 2007).

RESULTS AND DISCUSSION

The measures relevant for methods of estimation of the percentage of muscle tissue in pig carcasses acquired on a slaughter line are shown in *Table 1.* The most of the randomly chosen pig carcasses belonged to the group with medium carcass weight (80–100 kg). Statistically significant differences were found between the groups in measures of backfat and muscle thickness, but not in estimated or dissected lean percentage. The lightest group had significantly lowest backfat thickness; while there were no significant differences between the other two groups of carcasses in that respect. It is obvious that lean percentage was quite similar in all investigated carcasses, irrespective of carcass weight. There is common belief between the pig producers that lowering the carcass weight results in the increase of lean percentage due to the lowered backfat thickness. Results presented in this study could not support that idea. The reason for this can be in the fact that significant increase in backfat thickness was followed by proportional increase in the thickness of muscle measurements in the heavier groups of carcasses which differed among all investigated groups.

Table 2 presents the composition of the hams in absolute and relative terms of dissected tissues components. Naturally, heaviest carcasses had the heaviest hams; although in relative terms the difference between the groups was not statistically significant. Regarding the muscle tissue, significant difference was found between all investigated groups; the heaviest group produced the highest amount of muscle tissue, followed by the medium and light group. However, in relative terms, the lightest group had higher proportion of lean than the hams in other two groups. It can be observed that in the lightest group of carcasses, subcutaneous fat and IMF values were significantly lower than in other two groups in absolute and relative terms. The hams from the heavy group of pig carcasses had significantly more bones in absolute terms, comparing to other two groups, but bone percentage between the groups did not differ.

In *Table 3,* the differences in loin composition between the weight groups of carcasses is presented. Significant differences were found between all investigated groups in loin weight, the weight of muscle tissue and fat.

Table 1

Least square means and standard errors calculated for the on-line measures, predicted and dissected lean percentage in investigated groups of pig carcasses

Trait	Light (n=76)		Medium (n=128)		Heavy (n=37)	
	LS mean	S.E.	LS mean	S.E.	LS mean	S.E.
Carcass weight, kg	73.08 [a]	0.62	88.23 [b]	0.48	107.76 [c]	0.89
Sdt (mm)	13.04 [a]	0.64	15.92 [b]	0.49	18.76 [b]	0.92
Mdt (mm)	67.11 [a]	0.73	71.49 [b]	0.56	77.11 [c]	1.05
Estimated leanness (%)	57.74	0.54	56.66	0.42	55.67	0.78
Dissected lean (%)	55.06	0.68	54.43	0.52	54.60	0.97

Different superscripts within the row mean significant difference (P<0.05)

Table 2

LS means and standard errors calculated for the dissected components of ham in investigated groups of carcasses

Trait	Light (n=76)		Medium (n=128)		Heavy (n=37)	
	LS mean	S.E.	LS mean	S.E.	LS mean	S.E.
Ham (kg)	9.08[a]	0.14	10.70[b]	0.11	13.03[c]	0.21
Ham (%)	30.64	2.66	26.65	2.05	24.95	3.82
Muscle tissue (kg)	6.60 [a]	0.13	7.47 [b]	0.10	9.00 [c]	0.18
Muscle tissue (%)	73.03[a]	0.67	70.07 [b]	0.52	68.94[b]	0.96
Subcutaneous fat (kg)	1.54 [a]	0.05	2.04 [b]	0.04	2.57 [c]	0.08
Subcutaneous fat (%)	17.08[a]	0.53	19.22 [b]	0.41	20.07 [b]	0.75
IMF (kg)	0.29 [a]	0.02	0.39 [b]	0.01	0.54 [c]	0.02
IMF (%)	3.23 [a]	0.13	3.67 [b]	0.10	4.18 [b]	0.18
Bones (kg)	0.71[a]	0.06	0.81 [a]	0.05	1.10 [b]	0.09
Bones (%)	7.92	0.46	7.57	0.36	8.48	0.66

Different superscripts within the row mean significant difference (P<0.05)

Heavy group of carcasses had significantly more kilograms of bones in loins than both other groups, but in relative terms the situation is reversed. In relative terms there were no differences between the groups in the shares of loin in the carcass, intermuscular fat and muscle tissue in the loins. The percentage of IMF was the lowest in the group of light carcasses. Dissection of the loins of the heavy group of pig carcasses resulted in significantly higher amount of the bones in absolute terms than in other two groups; while the percentage of bones in the loin differed significantly between all three groups, being the highest in the light group of pig carcasses, followed by medium and heavy group.

The differences in composition of shoulder between the investigated groups of pig carcasses are shown in *Table 4.* The weight of shoulder significantly differs among the groups. Increase of warm carcass weight of pigs resulted in significant increase in the weight of dissected muscle tissue from the shoulder. However, percentage of muscle in this part was unaffected by the carcass weight of slaughtered pigs. Significantly lower amount of subcutaneous fat was dissected from the shoulders of the light group of pig carcasses; in the relative terms the difference between the groups was not significant.

Regarding the intermuscular fat, higher amounts were found in shoulders of the heavy group of pig carcasses when compared with the other two. When relative proportions were analysed it was found that lowest percentage of IMF in the shoulder had the medium group of carcasses, which differed significantly only from the heavy group. The amount of bones differed significantly between the groups, but the lowest percentage of bones was found in the shoulders from heavy group of pig carcasses, while other two groups did not differ in that respect.

Table 3

LS means and standard errors calculated for the dissected components of loin in investigated groups of carcasses

Trait	Light (n=76)		Medium (n=128)		Heavy (n=37)	
	LS mean	S.E.	LS mean	S.E.	LS mean	S.E.
Loin (kg)	5.36 [a]	0.09	6.59 [b]	0.07	7.90 [c]	0.13
Loin (%)	18.66	1.88	16.57	1.45	15.15	2.69
Muscle tissue (kg)	3.28 [a]	0.07	3.88 [b]	0.05	4.64 [c]	0.10
Muscle tissue (%)	61.32	0.78	59.00	0.60	58.48	1.12
Subcutaneous fat (kg)	1.17 [a]	0.06	1.62 [b]	0.04	2.11 [c]	0.08
Subcutaneous fat (%)	21.65 [a]	0.77	24.52 [b]	0.60	26.91 [b]	1.11
IMF (kg)	0.22 [a]	0.02	0.31b [b]	0.01	0.34 [b]	0.03
IMF (%)	4.16	0.25	4.68	0.19	4.34	0.36
Bones (kg)	0.69 [a]	0.02	0.77b[a]	0.01	0.81 [b]	0.02
Bones (%)	12.87 [a]	0.21	11.80 [b]	0.16	10.26 [c]	0.30

Different superscripts within the row mean significant difference (P<0.05)

Table 4

LS means and standard errors calculated for the dissected components of shoulder composition in investigated groups of carcasses

Trait	Light (n=76)		Medium (n=128)		Heavy (n=37)	
	LS mean	S.E.	LS mean	S.E.	LS mean	S.E.
Shoulder (kg)	4.45 [a]	0.07	5.12 [b]	0.05	5.90 [c]	0.10
Shoulder (%)	14.93	1.25	12.78	0.96	11.35	1.79
Muscle tissue (kg)	2.89 [a]	0.05	3.25 [b]	0.04	3.75 [c]	0.08
Muscle tissue (%)	65.25	0.73	63.42	0.56	63.38	1.04
Subcutaneous fat (kg)	0.88 [a]	0.04	1.10 [b]	0.03	1.24 [b]	0.05
Subcutaneous fat (%)	19.82	0.64	21.52	0.49	20.97	0.92
IMF (kg)	0.23 [a]	0.01	0.25 [a]	0.01	0.34 [b]	0.02
IMF (%)	5.25[ac]	0.19	4.83[ab]	0.14	5.71[ac]	0.27
Bones (kg)	0.48[a]	0.01	0.52[b]	0.01	0.58[c]	0.01
Bones (%)	10.90[a]	0.17	10.23 [a]	0.13	9.94 [b]	0.24

Different superscripts within the row mean significant difference (P<0.05)

The composition of the ribs of investigated groups of pig carcasses is shown in *Table 5.* The weight of this part is significantly increasing with the increase of whole carcass weight, as well as the amount of subcutaneous fat, IMF and bones in absolute terms.

Significantly lower amount of muscle tissue was found in the ribs of the light group than in other two groups which did not differ in that respect. In relative terms, only the percentage of bones dissected from the ribs differed significantly between all weight groups of pig carcasses; other components of the ribs from pig carcass groups did not differ in relative terms.

Table 5

LS means and standard errors calculated for the dissected components of the ribs in investigated groups of carcasses

Trait	Light (n=76)		Medium (n=128)		Heavy (n=37)	
	LS mean	S.E.	LS mean	S.E.	LS mean	S.E.
Ribs (kg)	3.13 [a]	0.07	4.06 [b]	0.05	5.20 [c]	0.10
Ribs (%)	10.70	1.04	10.17	0.80	9.98	1.48
Muscle tissue (kg)	1.78 [a]	0.11	2.31 [b]	0.09	2.73 [b]	0.16
Muscle tissue (%)	57.41	3.39	58.13	2.61	52.53	4.86
Subcutaneous fat (kg)	0.85 [a]	0.05	1.23 [b]	0.04	1.61 [c]	0.07
Subcutaneous fat (%)	26.72	0.98	29.86	0.75	30.87	1.40
IMF (kg)	0.28 [a]	0.02	0.38 [b]	0.02	0.53 [c]	0.03
IMF (%)	8.81	0.46	9.25	0.36	10.14	0.66
Bones (kg)	0.22 [a]	0.00	0.25 [b]	0.00	0.28 [c]	0.01
Bones (%)	7.06 [a]	0.12	6.25 [b]	0.09	5.37 [c]	0.18

Different superscripts within the row mean significant difference ($P<0.05$)

The results from the present study generaly confirm the pattern of increasing mass of different carcass joints and the belonging tissues together with weight of an animal as shown by growth many studies (*Davies and Kallweit,* 1979; *Gu et al.,* 1992; *Kouba et al.* 1999). Similar investigation to the one in the present study was performed by *Vališ et al.* (2008). They analysed lean meat content within the four carcass weight intervals. Generally, it was confirmed that the lean meat content was reduced with increasing carcass weight. Significant differences were found between the intervals up to 94.9 kg and above 95 kg which were in agreement with the studies of *Matoušek et al.,* (2001) and *Pulkrabek,* (2003). In addition, they found that the contribution of main cuts also significantly decreased in heavier carcasses. Authors suggested that with increasing carcass weight, the contribution of different cuts to the total lean meat content is reduced at the same rate. The results of these authors cannot be supported by the present study since the reduction in lean percentage with increasing carcass weight was observed only in ham.

CONCLUSIONS

On the basis of the results presented in this study it can be concluded that although significant differences existed in backfat and muscle thickness between the pig carcass weight groups, lean percentage predicted or established by dissection these carcasses was not significantly altered.

Although the main parts and tissues increased their weight in respect to the pig carcass weight group, the percentages of those rarely significantly differed between the weight groups of carcasses. This is especially important for the percentage of muscle tissue in the main parts which increased only in ham. As a general conclusion it can be

stated that increasing pig carcass weight does not necessarily have to impair other carcass traits or tissue distribution in the main parts.

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