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EFFECT OF TEMPERATURE AND ANATOMICAL LOCALISATION OF PORCINE CARCASS MEASUREMENT POINTS ON RESULTS OF EVALUATION OF BACKFAT AND LONGISSIMUS DORSI MUSCLE THICKNESS BY MEANS OF ULTRASOUND AND OPTICAL-NEEDLE DEVICES

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Background

Since the time when device assessment of meat content in porcine carcasses was introduced in meat industry, numerous studies were devoted to investigations concerned with the effect of various factors on results of thickness measurements of musculature indices (1,2,3,4). Errors in the meat content assessment can be attributed to the classifier during the process of taking measurements or to different other factors e.g. carcass thermal condition, the applied measurement method etc. The device method of carcass meat content assessment employs loin areas to measure the thickness of backfat and longissimus dorsi muscle (LD). Measurements are taken in different anatomical points using, for this purpose, indirect methods determining backfat and muscle thickness (5,6), i.e. ultrasound and optical-needle methods. Good and comprehensive knowledge of the influence of different factors on changes in backfat and LD muscle thickness can be useful for the analysis of correctness of meatiness evaluation by different devices.

Objective of research project

The objective of the study is to determine the effect of the carcass thermal condition and localisation of measurement points of backfat and LD muscle thickness on the results of meat content assessment by means of two methods: ultrasound and optical-needle.

Material and methods

Investigations were carried out on 30 carcasses selected randomly from a slaughter performed in one of domestic abattoirs. Backfat and LD muscle thickness were measured by ultrasound and optical-needle devises only on hot carcasses, and by a slide caliper on hot and chilled carcasses. Measurements were taken on several cross section carcass levels at various distances from the carcass mid-line.

Changes in backfat and LD muscle thickness caused by chilling were determined at point C_7, i.e. 7 cm from the carcass mid-line. For this purpose, carcasses were incised at the last rib and thickness was measure by a slide caliper before and after chilling.

Results and discussion

The device method of carcass meat content assessment employs loin part to measure the thickness of backfat and longissimus dorsi muscle. Results of these measurements taken by hand by a slide caliper on cut surfaces of chilled carcasses are given in Table 1.

The presented data reveal that backfat and LD muscle thickness does not change significantly in the distance 5 to 8 cm from the carcass mid-line but differs significantly between carcass cross-sectional levels. It can, therefore, be concluded that in the course of measurements, the final result can be influenced more by moving the measurement point vertically than horizontally.

Carcass dimensions undergo changes in the course of chilling in the result of basic laws of physics – thermal expansion and evaporation. Table 2 shows mean results of linear measurements performed on hot carcasses and after 24 hours of chilling.

The comparison of data presented in Table 2 allows to conclude that differences between measurements of hot and chilled carcasses taken along the carcass mid-line amount to approximately 6%. On the other hand, fat tissue shrinkage at measurement point C_7 was smaller and amounted to 4%. LD muscle thickness measured by a slide caliper was, on average, by 5.53% smaller in the result of chilling.

Measurement results of backfat and LD muscle thickness were also affected by the type of the applied devise. The examined ultrasound and optical-needle devises measure indirect tissue thickness utilising differences in the velocity with which ultrasound waves pass through backfat and meat or differences in the colour brightness of these tissues. Both these measurement techniques are usually burdened with some error which depends on the class of the assessed carcasses (Table 3).

Summing up the above investigations, it can be said that the thickness of backfat and LD muscle in the back part of the porcine carcass on which devise measurements are carried out with the aim to assess carcass meat content depends on several factors. One of them is the localisation of measurement points. It was shown that backfat and LD muscle thickness does not differ significantly depending on the distance of the measuring point from the carcass mid-line ranging from 5 to 8 cm. This finding is corroborated by results of Walstra (7) who showed that differences in devise evaluation of meatiness do not exceed a fraction of one percent (0.3 to 0.4%) as the measurement point was moved from 6 cm to 7 and 8 cm from the carcass mid-line.

On the other hand, backfat and LD muscle thickness differs considerably between points situated along the length of the carcass. Transfer of the measurement point from the level of the last rib to 3/4 ribs towards the head results in the increase of backfat and decrease of LD muscle thickness by 2.1 and 1.6 mm, respectively, i.e. reduction of carcass meatiness. These differences are even greater at the level of 5/6 ribs and amount to 4 and 2.4 mm, respectively. Similar results were obtained by Love (8) who showed that with the change of place of measurement by three vertebrae from the last rib down a hanging carcass, the backfat thickness increases by 10%. On the other hand, Walstra (7) found that moving the place of measurement 5 cm upwards from the level of the last rib increases meatiness by 1.5%, and when it is moved down the hanging carcass – its assessment is lower by 1.8%.

The second important factor which affects the determination accuracy of backfat and muscle thickness was the carcass thermal state. Our results indicate unequivocally that backfat and LD muscle thickness decreased in the result of chilling.

The third important factor influencing measurement accuracy of backfat and LD muscle thickness at point C of the hot carcass is measuring devises, in particular, measurement methods used in those devises. Investigations revealed that the mean backfat thickness at point C_7 established with the help of a slide caliper and using ultrasound and optical-needle devises did not differ statistically significantly.

The problem of measurement accuracy of backfat and muscle thickness using various devises looks differently if, instead of a mean of the entire population, we take into account analysis of measurement errors in groups characterised by different meatiness. The analysis of such data reveals that in the E carcass class, the thickness of the LD muscle determined by the ultrasound devise is by 9.8

mm lower than that established with a slide caliper and this difference is statistically highly significant (P=0.01). The analysed differences turned out to be statistically non-significant in classes R and O. However, in the case of backfat thickness and the ultrasound method, a significant increase of results is observed in class E (on average, 3.7 mm higher) and decrease in class O (on average, by 2.2 mm). In the case of the examined optic-needle devise, the analysed differences turned out to be considerably smaller, both with respect to the thickness of backfat and LD muscle.

Conclusions

1. Results of measurements of backfat and LD muscle thickness in the back part of carcasses depend on anatomical localisation of measurement points, thermal state of tissues and measurement method applied.
2. Results of measurements of tissue thickness obtained by means of the applied optical-needle devise are more precise than those obtained by means of the ultrasound devise.

Literature

Branscheid W.,Dobrowolski A., Höreth R.: Fleischwirt. 1991,71,760; 2. Dobrowolski A., Höreth R., Branscheid W.:Kulmbacher Reihe Band 1993,12,1; 3.Kempster A.J., Cook G.L.:Proc.EAAP-Symp. of the Commission on Pig Prod.Helsinki, July 1988,28; 4. Yujun Liu, Stoufter J.R.:J.An.Sci. 1995,73,29; 5.Borzuta K.:Rocz.Inst.Przem.Mięsn.i T³. 1998 XXXV/2,1; 6.Walstra P.: Proc.EAAP-Symp. of the Commission on Pig Prod. 1989,16; 7. Walstra P.: Proc. of Symp. Electr. Evaluation of Meat 1991, Pardue Univ., Indiana,293; 8. Love D.B.: Raport Meat and Livestock Comm. 1993, Milton Keynes.

Table 1. *Mean results of manual thickness measurements of backfat and musculus longissimus dorsi in 12 different points of the back part of chilled half-carcasses taken from loin cross section*

Tissue	Level of carcass cross section	Distance of points from mid-line				Mean levels of section
		5 cm	6 cm	7 cm	8 cm	
Backfat	Last rib	19.9	19.8	19.7	19.7	19.8a
	¾ last rib	21.7	21.8	22.1	22.0	21.9b
	5/6 last rib	23.9	23.9	23.8	23.7	23.8c
	Mean distance	21.8a	31.8a	21.9a	21.8a	
Muscle	Last rib	49.7	49.7	49.1	49.3	49.5a
	¾ last rib	48.2	48.0	47.8	47.8	47.9b
	5/6 last rib	47.3	47.5	46.8	46.8	47.1c
	Mean distance	48.4a	48.4a	48.0a	48.0a	-

a,b,c –Means designated with the same letters do not differ significantly (P>0.05)

Table 2. *Results of linear measurements taken with slide caliper on hot and chilled half-carcasses cut while warm and hanging*

Type of measurement	Carcass thermal state				Differences		Sign.of diffr
	Hot carcass		Chilled carcass		mm	%	
	x	s	x	s			
Backfat thickness at C_7, mm	14.8	4.4	14.2	4.3	0.6	4.05	0.012
m. LD thickness at C_7, mm	48.8	5.8	46.1	5.6	2.7	5.53	0.000
Backfat thickness on ham 1, mm (vs.m. gluteus medius)	27.3	6.2	25.6	6.0	1.7	6.23	0.000
Backfat thickness on ham 2, mm (vs.m. gluteus medius)	18.1	6.3	16.9	5.6	1.2	6.63	0.001

Table 3. *Mean results of measurements of backfat and LD muscle thickness at point C taken by slide caliper (SUW), ultrasound (US) and optical-needle (ON) devises depending on meatiness level*

Devise Type	Carcass class and mean meatiness	Stat. Trait	Last rib					
			Backfat, mm			LD muscle, mm		
			Device	SUW	Diff.	Devise	SUW	Diff.
US	E – 57.6%	x	12.2	8.5	3.7**	49.0	58.6	-9.6**
		s	3.33	3.12	(P≤0,01)	6.13	3.86	(P≤0,01)
	R – 48.2%	x	19.9	19.5	0.4	49.5	53.1	-3.6
		s	4.86	4.00		6.65	7.61	
	O – 40.1%	x	30.5	32.7	-2.2*	47.5	48.0	-0.5
		s	4.89	7.18	(P≤0,05)	5.96	8.08	
ON	E – 57.5%	x	14.6	12.6	2.0**	62.9	65.0	-2.1*
		s	2.34	1.19	(P≤0,05)	11.32	8.11	(P≤0,5)
	R – 47.3%	x	22.4	21.2	1.2	55.2	55.0	0.2
		s	4.06	4.54		10.87	5.80	
	O – 42.9%	x	29.2	28.10	1.1	51.1	50.8	0.3
		s	5.81	6.41		13.03	6.72	