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Relationship between backfat thickness and *longissimus dorsi* muscle measurements and carcass muscling in boars

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A total of 149 Polish Large White, Polish Landrace, Duroc, Hampshire, Pietrain and Line 990 boars from pedigree farms were investigated. Animals were selected for body weight to range from 95 to 125 kg and for meat content of carcass to range from 46 to over 60%. On the day of slaughter, live measurements of backfat thickness and *longissimus dorsi* (LD) muscle were taken at twelve points according to the procedures used in Poland (points P1, P2, P3, P4, P4M), Germany (points N1, N2, N3, N2M) and Denmark (points D1, D2, D2M). Thickness of backfat and LD was measured *post mortem* on right carcass-side according to the Polish Pig Testing Station methods. Live measurements of backfat and LD thickness on the back, on the side and behind the last vertebra (points P2, P4, P4M) appeared to be good indicators of meat content of carcass on live boars. Correlations between these measurements and post-slaughter meat content of carcass based on detailed dissection were: -0.718 (for P2), -0.741 (for P4), and 0.443 (for P4M). Of all *post mortem* measurements of backfat thickness, the best indicators for determining meat content of carcass are measurements at sacrum point III and at point C1. The correlations between these measurements and meat content of carcass were: -0.732 (for backfat thickness at sacrum point III) and -0.721 (for backfat thickness at point P1).

KEY WORDS: boars / carcass / meat content /pigs

When starting to improve a population of animals, its current value in terms of fattening and slaughter traits should be determined in the first place. In breeding and selection work, the muscling and fatness of young animals are commonly evaluated using live ultrasound measurements of backfat and *longissimus* muscle thickness. In this report, fattening and slaughter value as indicated by daily gain and meat content of carcass, are the parametres of the selection index, which is the basic criterion for the selection of animals for further breeding [Eckert and Szyndler 1996].

Relationships between backfat thickness and carcass muscling and fatness were investigated by many authors. Trukhiljo *et al.* [1982] reported that backfat measurements of a live animal over the shoulder and at sacrum were correlated with carcass meat percentage (r = -0.25 and -0.51, respectively). Slightly higher coefficients of correlation between these parametres (-0.52 and -0.64) were estimated by Blendl *et al.* [1980]. Pommert *et al.* [1981] found backfat thickness measured off the midline to be more accurate indicator of carcass muscling and fatness. Also Blendl *et al.* [1981] and Oster *et al.* [1987] reported that measurements of backfat thickness on the side show highest correlations with carcass muscling and fatness (r = -0.7 and 0.8, respectively).

The objective of this study was to determine relationships between backfat and *longissimus dorsi* muscle thickness measured *in vivo* and *post mortem* and carcass fatness determined basing on direct detailed dissection.

Material and methods

A total of 149 boars from pedigree farms were selected for body weight to range from 95 to 125 kg and for each body weight range (at 10 kg intervals) to correspond to carcass meat percentage of 46 to 60%.

On the day of slaughter, live measurements were taken at the following points:

P1 – backfat thickness on a vertical line tangential to the elbow joint (near the 6th and 7th thoracic vertebrae), 3 cm off the midline;

P2 – backfat thickness behind the last rib (at the boundary of thoracic and lumbar vertebrae), 3 cm off the midline;

P3 – backfat thickness on a vertical line tangential to the hock joint (near the penultimate lumbar vertebra), 3 cm off the midline;

P4 – backfat thickness behind the last rib (at the boundary of thoracic and lumbar vertebrae), 8 cm off the midline;

P4M – LD thickness behind the last rib at point P4 (at the boundary of thoracic and lumbar vertebrae), 8 cm off the midline;

N2 – backfat thickness between the shoulder and the ham, 6 cm off the midline;

N1 – backfat thickness 15 cm anterior to point N2, 6 cm off the midline;

N3 – backfat thickness 15 cm posterior to point N2, 6 cm off the midline;

N2M – LD thickness at the point of backfat measurement N2;

D1 – backfat thickness between the 3rd and 4th lumbar vertebrae counted from the back, 7 cm off the midline;

D2 – backfat thickness between the 3rd and 4th thoratic vertebrae counted from the back, *i.e*. approximately 10 cm from the junction of the last rib and spine in the cephalic direction, 7 cm off the midline;

D2M – LD thickness at the point of backfat measurement point D2.

Letters "P" designate points of measurements according to the live testing procedures used in Poland [Eckert and Szyndler 1996].

Letters "N" designate points of measurements according to the live testing procedures used in Germany [Blendl *et al.* 1989].

Letters "D" designate points of measurements according to the live testing procedures used in Denmark (Piglog guidelines).

Live measurements of backfat and LD muscle were taken with ultrasound device Piglog 105. Thereafter animals were slaughtered and after 24 h cooling of carcasses at 4°C, the right sides were measured for:

– backfat thickness over the shoulder;
– backfat thickness on the back;
– backfat thickness over the sacrum point I, II, III;
– backfat thickness at points C_1 and K_1;
– loin eye width and height at the intersection behind the last rib;
– loin eye area.

Next, the carcass-sides were divided into primary cuts (neck, shoulder, ham, rear ham, loin and belly with ribs) which were then dissected into meat, fat, bone and skin [Różycki 1996].

Numerical data were evaluated by simple correlations between *in vivo* and post-slaughter measurements of backfat and LD thickness, and carcass meat weight (kg) and content (%).

Results and discussion

Table 1 shows coefficients of simple correlation between live measurements of backfat and LD muscle thickness and carcass meat weight (kg) and content (%). The estimated correlation coefficients were highly significant. The highest correlations were obtained for ultrasound measurements of backfat and meat content of carcass. The coefficients ranged from -0.521 (backfat thickness at P3) to -0.774 (backfat thickness at N1). Much lower coefficients of correlation were found between live measurements of backfat and meat weight, ranging from -0.189 (P3) to -0.373 (P1). Ultrasonic measurements of LD muscle thickness at P4M and N2M showed the highest correlation with carcass meat content (0.443 and 0.522, respectively). Slightly lower correlations were estimated between these measurements of muscle thickness and meat weight (0.433 for P4M, and 0.477 for N2M). The correlations for LD thickness at point D2M followed a different pattern. The highest correlation was found between D2M and carcass meat weight (0.514), and much lower between D2M and carcass meat content (0.387).

The literature showed correlations between live measurements of backfat and muscle thickness and carcass meat weight. Lower correlation coefficients were observed for LD thickness measurements (from 0.260 to 0.364) than for backfat thickness (from -0.396 to -0.551) – Adamczyk *et al*. [1996]. Hick *et al.* [1998] estimated a very high correlation between carcass meat weight and muscle thickness (r = 0.81)

Table 1. Simple correlations between live measurements of backfat and muscle thickness, and meat weight and percentage in boar carcasses

Live measurements	Meat weight	% meat
P1	-0.373**	-0.674**
P2	-0.339**	-0.718**
P3	-0.189*	-0.521**
P4	-0.315**	-0.741**
N1	-0.360**	-0.774**
N2	-0.367**	-0.740**
N3	-0.311**	-0.721**
D1	-0.360**	-0.698**
D2	-0.341**	-0.724**
P4M	0.433**	0.443**
N2M	0.477**	0.522**
D2M	0.514**	0.387**

*P≤0.05.
** P≤0.01.

and a low for backfat thickness (r = -0.33). Our own results are in agreement with the findings of Hick *et al.* [1998]. We obtained higher correlations with carcass meat weight for ultrasound measured muscle thickness and lower correlations for backfat thickness.

Our analysis of simple correlation coefficients between live measurements of backfat and LD muscle thickness and meat content of carcass proved that the use of live ultrasound measurements of backfat thickness at points P2 and P4 and muscle thickness (P4M) in the current testing methodology enables to assess *in vivo* the meat content of boar carcasses. The correlation coefficients between backfat thickness measured at points P2 and P4 and meat content of carcass were high (-0.718 and -0.741, respectively), while those between muscle thickness measured at point P4M and meat content of carcass reached lower value (0.443). High correlations with meat content of carcass were also observed for backfat thickness at points N1 (-0.774), N2 (-0.740), N3 (-0.721) and D2 (-0.724). Higher correlations with meat content of carcass for backfat thickness measurement points N1, N2, N3, D2 compared to P2 and P4, could result from changes in anatomical structure of boars due to selection for backfat thickness at points P2 and P4. As a result, wider variation of backfat thickness was observed at points N1, N2, N3 and D2. Similarly high correlations between backfat & muscle thickness and meat content of carcass was found in live animals by Blendl *et al.* [1980] and Trukhiljo *et al*. [1982]. These studies estimated correlation between backfat thickness and muscling to be -0.64, which is similar to the correlation coefficients obtained in the present study. Smith *et al.* [1992] reported lower correlation coefficients between backfat thickness and muscle thickness behind the last rib and meat content of carcass (-0.51 and 0.25, respectively). Slightly higher correlation co-

efficient (-0.60) with meat content of carcass was obtained for measurement of backfat thickness behind the 10th rib.

Table 2 presents simple correlation coefficients between backfat and LD thickness measured *post mortem* and carcass meat weight (kg) and content (%). All correlation coefficients were highly significant except those between backfat thickness measured on the back and meat weight. The highest correlations were obtained for backfat thickness and meat content of carcass. These correlations varied between -0.462 (for backfat thickness measured on the back) to -0.732 (for backfat thickness at sacrum point III). Much weaker relationships were found between *post mortem* backfat measurements and meat weight, ranging from -0.145 (for backfat thickness measured on the back) to -0.345 (for backfat thickness at sacrum point III).

Table 2. Simple correlations between *post mortem* measurements of backfat and muscle thickness, and meat weight and percentage in boar carcasses

Post mortem measurements	Meat weight	% meat
Backfat thickness over shoulder	-0.225**	-0.558**
Backfat thickness on back	-0.145	-0.462**
Backfat thickness at sacrum I	-0.340**	-0.705**
Backfat thickness at sacrum II	-0.332**	-0.700**
Backfat thickness at sacrum III	-0.345**	-0.732**
Backfat thickness C1	-0.343**	-0.721**
Loin eye width	0.614**	0.520**
Loin eye height	0.594**	0.482**
Loin eye area	0.789**	0.651**

* $P \leq 0.05$
** $P \leq 0.01$.

Measurements of loin eye width, height and area showed the highest correlations with meat weight, ranging from 0.594 (loin eye height) to 0.789 (loin eye area). Slightly weaker relationships were found between these muscle measurements and meat content of carcass.

A detailed analysis of the simple correlation coefficients between *post mortem* measurements of backfat and muscle thickness and meat content of carcass showed that the highest relations with carcass meat percentage exist between backfat thickness at sacrum point III or C_1. In case of measurements of backfat thickness the coefficients were -0.732 at sacrum point III and -0.721 at point C_1. Lower were correlation coefficients between backfat thickness measured on the shoulder and on the back and carcass meat weight (-0.558 and -0.462, respectively). They followed a similar pattern to the correlation values between *post mortem* muscle thickness and muscling (from 0.482 for loin eye height to 0.651 for loin eye area). Similar figures were published by Blicharski and Ostrowski [1997], who reported high correlations between

carcass muscling and backfat thickness over the last rib (-0.76), backfat thickness at sacrum point I (-0.74), and loin eye height (0.74). Slightly lower correlations between backfat thickness and carcass muscling were obtained by Borzuta *et al.* [1995]. They estimated the correlation coefficient between backfat thickness on the back and on the carcass side behind the last rib and carcass meat content to be -0.80 and -0.78, respectively. The same authors showed lower correlations between meat content of carcass and muscle thickness measured around the back (0.42), as well as measured near the last rib, 8 cm off the carcass intersection (0.45). These data are similar to figures presented in this report when estimating the meat content of carcass basing on muscle thickness measured around the back. Also Dempfle *et al.* [1988] estimated very high correlations between backfat thickness measured between the 3rd and 4th rib and carcass muscling (-0.83), while the correlation with muscle thickness between the 3rd and 4th rib was lower (0.447).

The data presented here demonstrate that live measurements of backfat and *longissimus* muscle on the back and on carcass side, behind the last rib (at P2, P4, P4M) are good indicators of the meat content of carcass in live boars. Among the *post mortem* measurements of backfat thickness the best indicators of meat content of carcass are the measurements taken at sacrum point III and point C_1.

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Zależności między pomiarami grubości słoniny i mięśnia najdłuższego grzbietu a umięśnieniem tuszy knurów

S t r e s z c z e n i e

Materiał doświadczalny stanowiło 149 knurów pochodzących z chlewni zarodowych. Doboru zwierząt do badań dokonano tak, aby reprezentowały przedział masy ciała od 95 kg do 125 kg oraz aby procent mięsa w tuszy wahał się od 46 do ponad 60%. W dniu uboju zwierząt przeprowadzono przyżyciowe pomiary grubości słoniny i mięśnia najdłuższego grzbietu w dwunastu punktach, zgodnie z metodami stosowanymi w Polsce (punkty P1, P2, P3, P4, P4M), w Niemczech (punkty N1, N2, N3, N2M) i Danii (punkty D1, D2, D2M). Po uboju wykonano pomiary grubości słoniny i mięśnia najdłuższego grzbietu na prawej półtuszy, zgodnie z metodyką stosowaną w SKURTCh.

Przeprowadzone badania wykazały, że przyżyciowe pomiary grubości słoniny i mięśnia najdłuższego grzbietu wykonywane na grzbiecie i boku tuszy, za ostatnim żebrem (w punktach P2, P4, P4M) są dobrymi wskaźnikami, na podstawie których można określić zawartość mięsa w tuszy żywych knurów. Wartości korelacji między tymi pomiarami, a mięsnością knurów określoną na podstawie dysekcji szczegółowej wyniosły: -0,718 (dla P2), -0,741 (dla P4) i 0,443 (dla P4M). Najlepszymi wskaźnikami do określania mięsności tuszy spośród poubojowych pomiarów grubości słoniny są pomiary wykonane na krzyżu III i w punkcie C1. Współczynniki korelacji między tymi pomiarami, a mięsnością wyniosły odpowiednio: -0,732 (dla grubości słoniny na krzyżu III) i -0,721 (dla grubości słoniny w punkcie C1).