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PARAMETERS OF FATTENING PERFORMANCE, SLAUGHTER PERFORMANCE AND MEAT QUALITY AS RELATED TO FEED CONVERSION EFFICIENCY IN PIGS* *

M i r o s ł a w T y r a , A u r e l i a M u c h a , R o b e r t E c k e r t

National Research Institute of Animal Production, Department of Pig Breeding, 32-083 Balice near Krakow

The objective of the study was to determine the relationships between feed conversion efficiency per 1 kg of daily weight gain and fattening traits, slaughter traits and meat quality of pigs, and to determine the correlations between feed conversion per 1 kg of weight gain in particular periods of fattening test and selected traits. The experimental material consisted of 122 gilts originating from nucleus herds and performance tested in the Pig Slaughter Performance Testing Station. As a result of the study, pigs were divided into subgroups according to feed conversion efficiency. Positive relationships were found between most of the analyzed fattening traits and feed conversion per kg of weight gain. More favourable parameters were observed in animals that converted feed more efficiently per body weight gain (P≤0.01), as also evidenced by high correlations between these traits. Animals with better feed conversion per body weight gain also showed better parameters of carcass meatiness and its most valuable cuts, but statistically significant differences were only confirmed for loin eye height and area, meat content in primal cuts, and carcass meat percentage (P≤0.05). For the meat quality traits, the analyzed feed conversion ratio had a statistical significant influence on water holding capacity (P≤0.01) and yellowness of the meat (P≤0.05).

Key words: pigs, efficiency of feed conversion, fattening traits, slaughter traits, meat quality

The final result regarding the profitability of production is the balance of the costs incurred for production carried out and profits generated from it. Individual's ability in terms of feed conversion per daily weight gain is the factor, which has an impact on cost-generating item of the whole fattening process, that is feed costs, which account for 70% of the costs incurred (Pepliński, 2013).

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In conditions of controlled feeding, daily weight gains depend on the capacity for daily protein deposition. In this respect, significant differences are observed in pigs, which are influenced by a number of factors, however, animal breed is of major importance here (Gjerlaug-Enger et al., 2012). Within the breed, the differentiation is observed between the sexes in favour of young boars and hogs (Saintilan et al., 2012), but still, the differences are reduced along with genetic improvements (Schinckel, 1999). By applying standardized feeding, modern pig genotype within the same sex is characterized with variability at 8% in this respect, however in case of *ad libitum* feeding it is as high as 20%. It is this data that laid the basis for the division of the test material into the groups differentiating the animals in terms of feed conversion efficiency per 1 kg of weight gain.

The aim of the study was to determine the relationships between feed conversion efficiency per 1 kg of daily weight gain and fattening traits, slaughter traits and meat quality of pigs, and to determine the correlations between feed conversion per 1 kg of weight gain in particular periods of fattening test and selected traits.

Material and methods

The experimental material consisted of 122 Polish Landrace gilts originating from boars and sows from nucleus herds and performance tested in the Pig Slaughter Performance Testing Station (SKURTCh). The animals were kept and fed on an individual basis, according to the feeding program in testing stations. Fattening test was started when the animals reached 30 kg body weight and was completed when they reached 100 kg. The pigs were fed *ad libitum* with standard pelleted feed. Feeding with two compound feeds applied throughout a period of the fattening test. In the period of feeding with the first one (13.5 MJ/kg and 17–19% of crude protein), the most efficient feed conversion and the greatest lean muscle growth was noted. As the animals reached 80 kg body weight, the first compound feed was replaced with the second one (13.0 MJ/kg and 16–18% of crude protein), which aimed at quick end of animal fattening, to avoid excessive fat accumulation. The feed contained smaller amount of exogenous amino acids with slightly reduced energy concentration within it and was characterized by lower protein content. Automatic individual feeding systems were strewn with certain quantity of feed every morning and the amount of added feed was controlled in the afternoon in order to ensure the animals are fed *ad libitum* all day long. The quantity of the dispensed feed and the amount of uneaten feed were recorded daily, individually for each animal. The animals were weighed every 3 days (in case of feast days the period was 4 days). For days between consecutive weighings, body weight was calculated on the basis of interpolation. After the end of fattening and when the animals attained average final body weight of 100 kg, they were subjected to slaughter and dissection in accordance with SKURTCh methodology. The statistical analysis included the following parameters:

1) Fattening traits: number of days of grow-finish phase from 30 to 100 kg body weight, daily weight gain in the test (from 30 to 100 kg body weight), total feed intake during fattening, daily feed intake, feed conversion per 1 kg of weight gain;

2) Slaughter traits: body weight at slaughter, weight of right half-carcass, dressing percentage, weight of loin, weight of loin backfat with skin, weight of loin without skin and backfat, weight of leg, weight of knuckle, weight of ham, weight of ham backfat with skin, weight of knuckle backfat and skin, weight of leg without backfat and skin, mean backfat thickness from 5 measurements at 5 points: over the shoulder at the thickest point, on the back above the joint at the intersection of the last thoracic vertebra and the first lumbar vertebra, at 3 points on sacrum: over cranial (sacrum point I), median (sacrum point II) and caudal (sacrum point III) edge of the section of gluteus medius muscle; loin eye width, loin eye height, loin eye area, C1 backfat thickness, meat content in primal cuts, carcass meat percentage;

3) Meat quality traits: in loin – measurement of pH 45 min. postmortem and 24 h postmortem, intramuscular fat (IMF) content, water holding capacity, colour lightness (L), redness (a*), yellowness (b*) and in ham – measurement of pH 45 min. postmortem and 24 h postmortem. The meat acidity (pH45 and pH24) was determined by means of pH-CPU-Star device from Matthäus. Intramuscular fat (IMF) content in meat was determined as the so-called crude fat using Soxhlet method by extraction in Soxthern 600 device from GERHARD. Water holding capacity was determined with Grau and Hamm’s method. Meat colour was determined using Minolta CR-310 Meter. Meat samples for testing were taken by dissecting longissimus dorsi muscle.

Transversal cut of loin was carried out at the intersection of the last thoracic vertebra and the first lumbar vertebra in order to trace the contour of its cross-section (on foil), on the cephalic plane. The following were plotted and measured on the contour: loin eye width, height, surface area of the loin eye, C1 backfat thickness (on the prolongation of height measurement). Meat content in primal cuts was calculated using the formula currently applicable in testing stations:

$$y = 1{,}745x_1 + 0{,}836x_2 + 0{,}157x_3 - 1{,}884$$

where:

y – calculated meat content, kg,

x_1 – leg without backfat and skin, kg,

x_2 – loin without backfat + tenderloin, kg,

x_3 – double width + height of the loin eye (2A + B), cm.

Statistical analysis

Statistical analysis was performed with analysis of variance using models of the SAS statistical package. The statistical model used for the calculations had the form:

$$y_{ij} = \mu + a_i + \beta(a_i) + e_{ij}$$

where:

y_{ij} – individual observations of the animals,
μ – overall mean,
a_i – the effect of ith group in terms of feed conversion efficiency (1,2,3), $\beta(a_i)$ – covariance on right half-carcass weight (accompanying change),
e_{ij} – error.

In order to provide greater understanding of the relationship between feed conversion efficiency and the development of fattening, slaughter parameters and meat quality, the animals were divided into groups in terms of feed conversion per 1 kg of weight gain. The first one was characterized by feed conversion efficiency up to 2.54 kg (population average –½ standard deviation), the second one ranged from 2.54 kg to 2.78 kg (ranging from "mean –½ standard deviation" to "mean +½ standard deviation") and the third one above 2,78 kg (mean +½ standard deviation). The differences among the tested experimental groups in terms of particular fattening, slaughter traits and meat quality were estimated at a level of 5% and 1% using Duncan's multiple range test. Moreover, correlations were estimated between feed conversion per 1 kg of weight gain in various age groups and a group of fattening, slaughter traits and meat quality.

Results

Table 1 shows the results of the analysis of the effect of feed conversion efficiency per 1 kg of weight gain on selected fattening traits. In case of the majority of the analyzed fattening traits, it was noted that there was statistically proven higher number of animals more efficient in converting feed per 1 kg of weight gain. The animals gained more weight in the test, thanks to which they reached slaughter weight of 100 kg faster than the others. Total feed conversion during fattening was also much lower and showed statistically significant differences in relation to the remaining groups ($P \leq 0.01$), which has a significant influence on the profitability of fattening. The observed differences in the size of the dividing factor (feed conversion efficiency per 1 kg of weight gain) were considerable and for very different groups they amounted to 0.54 kg of feed per 1 kg of weight gain. The observed differences were statistically significant ($P \leq 0.01$) among each of the observed groups.

Table 2 illustrates the results of the analysis of the effect of feed conversion efficiency per 1 kg of weight gain on selected slaughter traits. Out of the range of the analyzed slaughter indicators, significant differences were observed solely for the parameters related to meat quality factor of carcasses. The animals more efficient in converting feed per daily weight gain, reached higher, statistically valid ($P \leq 0.05$) meatiness of half-carcasses, and also higher meat content in primal cuts ($P \leq 0.05$). They were also characterized by statistically greater loin eye ($P \leq 0.05$), and, accordingly, loin eye height ($P \leq 0.05$). Statistically significant differences were not observed in case of the remaining indicators.

Tabela 1. Analiza wpływu efektywności wykorzystania paszy na 1 kg przyrostu na wybrane cechy tuczne
Table 1. Analysis of the effect of feed conversion efficiency on selected fattening traits

Cechy Traits	Wykorzystanie paszy na 1 kg przyrostu dziennego (kg) Feed conversion efficiency (kg feed/kg gain)		
	do 2,54 up to 2.54 (41)	od 2,55 do 2,78 from 2.55 to 2.78 (45)	powyżej 2,78 above 2.78 (36)
Liczba dni tuczu od 30 do 100 kg masy ciała (kg) Number of fattening days from 30 to 100 kg body weight (kg)	69.8 AC	74.2 BC	82.6 AB
Przyrost dzienny w teście (g) Daily gain on test (g)	999 AC	943 BC	853 AB
Łączne spożycie paszy w czasie tuczu (kg) Total feed consumption during fattening (kg)	168 AC	185 BC	207 AB
Wykorzystanie paszy na 1 kg przyrostu (kg) Feed conversion (kg feed/kg gain)	2.42 AC	2.66 BC	2.96 AB
Dzienne pobranie paszy (kg) Daily feed intake (kg)	2.41	2.51	2.52
Masa ciała w dniu uboju (kg) Body weight at slaughter (kg)	99.5	99.5	99.9

Wartości oznaczone tymi samymi literami oznaczały istotności różnic pomiędzy grupami na poziomie (A, B, C = P<0,01; a, b, c = P<0,05)
Values with the same letters show significant differences between the groups (A, B, C = P<0.01; a, b, c = P<0.05).

The situation was similar in case of the analyzed indicators of meat quality (Table 3). The analyzed feed conversion ratio had an impact solely on the level of water holding capacity ($P \leq 0.01$) and to a lesser degree on the yellowness of the analyzed meat ($P \leq 0.05$). For the remaining meat quality traits, the observed differences were not statistically validated.

Tabela 2. Analiza wpływu efektywności wykorzystania paszy na 1 kg przyrostu na wybrane cechy rzeźne
Table 2. Analysis of the effect of feed conversion efficiency on selected slaughter traits

Cechy Traits	Wykorzystanie paszy na 1 kg przyrostu dziennego (kg) Feed conversion efficiency (kg feed/kg gain)		
	do 2,54 up to 2.54 (41)	od 2,55 do 2,78 from 2.55 to 2.78 (45)	powyżej 2,78 above 2.78 (36)
1	2	3	4
Masa półtuszy prawej (kg) Weight of right half-carcass (kg)	39.1	39.2	39.3
Wydajność rzeźna (%) Dressing percentage	78.7	78.7	78.8
Masa polędwicy (kg) Weight of loin (kg)	7.73	7.78	7.69

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Table 2 – contd.

1	2	3	4
Masa słoniny polędwicy ze skórą (kg) Weight of loin backfat with skin (kg)	1.70	1.80	1.77
Masa polędwicy bez skóry i słoniny (kg) Weight of loin without skin and backfat (kg)	6.03	5.98	5.92
Masa szynki zadniej (kg) Weight of leg (kg)	10.12	9.98	10.00
Masa golonki (kg) Weight of knuckle (kg)	1.31	1.29	1.30
Masa szynki właściwej (kg) Weight of ham (kg)	8.81	8.69	8.69
Masa słoniny szynki właściwej ze skórą (kg) Weight of ham backfat with skin (kg)	1.32	1.35	1.41
Masa słoniny i skóry golonki (kg) Weight of knuckle backfat and skin (kg)	0.219	0.219	0.23
Masa szynki zadniej bez słoniny i skóry (kg) Weight of leg without backfat and skin (kg)	8.58	8.41	8.36
Średnia grubość słoniny z 5 pomiarów (cm) Mean backfat thickness from 5 measurements (cm)	1.61	1.61	1.61
Szerokość „oka” polędwicy (cm) Loin eye width (cm)	10.69	10.43	10.58
Wysokość „oka” polędwicy (cm) Loin eye height (cm)	6.84 a	6.69 b	6.59 ab
Powierzchnia oka polędwicy (cm_2) Loin eye area (cm_2)	53.7 ab	51.8 b	51.7 a
Grubość słoniny w punkcie C_1 (cm) C_1 backfat thickness (cm)	1.23	1.31	1.36
Zawartość mięsa w wyrębach podstawowych (%) Meat content in primal cuts (%)	66.9 ab	65.6 b	65.0 a
Zawartość mięsa w tuszy (%) Carcass meat percentage	58.7 ab	57.5 b	56.9 a

Wartości oznaczone tymi samymi literami oznaczały istotności różnic pomiędzy grupami na poziomie (A, B, C = P<0,01; a, b, c = P<0,05).
Values with the same letters show significant differences between the groups (A, B, C = P<0.01; a, b, c = P<0.05).

Moreover, the relationships were determined between the selected fattening, slaughter parameters, meat quality indicator and feed conversion efficiency per 1 kg of weight gain. The results of the analyses were presented in Tables 4-6. The correlations were estimated in three fattening periods: the first three weeks (week 1-3), 4th, 5th and 6th week (week 4-6) and from 7th to 9th week (week 7-9), as well as during the whole fattening period.

Tabela 3. Analiza wpływu efektywności wykorzystania paszy na 1 kg przyrostu na wybrane cechy jakości mięsa
Table 3. Analysis of the effect of feed conversion efficiency on selected meat quality traits

Cechy Traits	Wykorzystanie paszy na 1 kg przyrostu dziennego (kg) Feed conversion efficiency (kg feed/kg gain)		
	do 2,54 up to 2.54 (41)	od 2,55 do 2,78 from 2.55 to 2.78 (45)	powyżej 2,78 above 2.78 (36)
Polędwica – Loin			
pH 45 minut po uboju pH 45 min postmortem	6.36	6.39	6.33
pH 24 godziny po uboju pH 24 h postmortem	5.61	5.59	5.61
Tłuszcz śródmięśniowy (%) Intramuscular fat (%)	1.28	1.30	1.33
Wodochłonność mięsa (%) Water holding capacity (%)	40.7 A	39.1 B	37.1 AB
Intensywność barwy (L*) Colour lightness (L*)	54.7	54.95	54.3
Wysycenie barwy czerwonej (a*) Redness (a*)	17.06	17.10	17.16
Wysycenie barwy żółtej (b*) Yellowness (b*)	2.56 a	2.58 b	2.25 ab
Szynka – Ham			
pH 45 minut po uboju pH 45 min postmortem	6.32	6.36	6.35
pH 24 godziny po uboju pH 24 h postmortem	5.64	5.67	5.66

Wartości oznaczone tymi samymi literami oznaczały istotności różnic pomiędzy grupami na poziomie (A, B, C = P<0,01; a, b, c = P<0,05).
Values with the same letters show significant differences between the groups (A, B, C = P<0.01; a, b, c = P<0.05)

Tabela 4. Korelacje pomiędzy wykorzystaniem paszy na 1 kg przyrostu w poszczególnych okresach tuczu kontrolnego a cechami tucznymi
Table 4. Correlations between feed conversion efficiency during different periods of fattening test and fatness traits

Cechy Traits	1–3 tydzień weeks 1–3	4–6 tydzień weeks 4–6	7–9 tydzień weeks 7–9	cały okres weeks 1–9
Liczba dni tuczu od 30 do 100 kg masy ciała (kg) Number of fattening days from 30 to 100 kg body weight (kg)	0.301**	0.296**	0.103	0.623**
Przyrost dzienny w teście (g) Daily gain on test (g)	–0.263**	–0.316**	-0.102	–0.626**
Łączne spożycie paszy w czasie tuczu (kg) Total feed consumption during fattening (kg)	0.133	0.479**	0.459**	0.950**
Dzienne pobranie paszy (kg) Daily feed intake (kg)	–0.092	0.078	0.127	0.285**

** Korelacje statystycznie wysoko istotne na poziomie P<0,01.
* Korelacje statystycznie istotne na poziomie P<0,05.
** Highly significant correlations at P<0.01.
* Significant correlations at P<0.05.

Tabela 5. Korelacje pomiędzy wykorzystaniem paszy 1 kg przyrostu w poszczególnych okresach tuczu kontrolnego a cechami rzeźnymi

Table 5. Correlations between feed conversion efficiency during different periods of fattening test and slaughter traits

Cechy Traits	1–3 tydzień weeks 1–3	4–6 tydzień weeks 4–6	7–9 tydzień weeks 7–9	cały okres weeks 1–9
Masa półtuszy prawej (kg) Weight of right half-carcass	–0.032	–0.029	–0.066	–0.006
Wydajność rzeźna (%) Dressing percentage	–0.124	0.002	–0.016	0.017
Masa polędwicy (kg) Weight of loin (kg)	–0.065	0.081	0.090	–0.012
Masa słoniny polędwicy ze skórą (kg) Weight of loin backfat with skin (kg)	0.023	0.101	0.319**	0.146
Masa polędwicy bez skóry i słoniny (kg) Weight of loin without skin and backfat (kg)	–0.105	0.006	–0.191*	–0.155
Masa szynki zadniej (kg) Weight of leg (kg)	0.028	–0.094	–0.299**	–0.159
Masa golonki (kg) Weight of knuckle (kg)	–0.050	0.033	–0.098	–0.042
Masa szynki właściwej (kg) Weight of ham (kg)	0.039	–0.105	–0.299**	–0.162
Masa słoniny szynki właściwej ze skórą (kg) Weight of ham backfat with skin (kg)	0.103	0.091	0.201*	0.201*
Masa słoniny i skóry golonki (kg) Weight of knuckle backfat and skin (kg)	0.134	0.109	0.092	0.227*
Masa szynki zadniej bez słoniny i skóry (kg) Weight of leg without backfat and skin (kg)	–0.017	–0.120	–0.339**	–0.222*
Średnia grubość słoniny z 5 pomiarów (cm) Mean backfat thickness from 5 measurements (cm)	0.025	0.003	0.287**	0.075
Szerokość „oka” polędwicy (cm) Loin eye width (cm)	–0.079	–0.048	–0.244**	–0.135
Wysokość „oka” polędwicy (cm) Loin eye height (cm)	0.010	–0.015	–0.264**	–0.211*
Powierzchnia „oka” polędwicy (cm^2) Loin eye area (cm^2)	–0.013	–0.071	–0.289**	–0.195*
Grubość słoniny w punkcie C_1 (cm) C_1 backfat thickness (cm)	0.028	0.152	0.289**	0.242**
Zawartość mięsa w wyrębach podst. (%) Meat content in primal cuts (%)	–0.038	–0.084	–0.364**	–0.266**
Zawartość mięsa w tuszy (%) Carcass meat percentage	–0.042	–0.099	–0.386**	–0.281**

** Korelacje statystycznie wysoko istotne na poziomie P<0,01.
* Korelacje statystycznie istotne na poziomie P<0,05.
** Highly significant correlations at P<0.01.
* Significant correlations at P<0.05.

Tabela 6. Korelacje pomiędzy wykorzystaniem paszy w poszczególnych okresach tuczu kontrolnego a cechami jakości mięsa
Table 6. Correlations between feed conversion efficiency during different periods of fattening test and meat quality traits

Cechy Traits	1–3 tydzień weeks 1–3	4–6 tydzień weeks 4–6	7–9 tydzień weeks 7–9	cały okres weeks 1–9
Polędwica – Loin				
pH 45 minut po uboju pH 45 min postmortem	–0.005	–0.011	–0.157	–0.058
pH 24 godziny po uboju pH 24 h postmortem	–0.037	0.083	–0.181*	–0.015
Tłuszcz śródmięśniowy (%) Intramuscular fat (%)	0.113	0.051	0.122	0.177
Wodochłonność mięsa (%) Water holding capacity (%)	–0.158	–0.161	–0.054	–0.292**
Intensywność barwy (L*) Colour lightness (L*)	–0.120	–0.027	–0.126	–0.115
Wysycenie barwy czerwonej (a*) Redness (a*)	0.000	0.070	0.179*	0.074
Wysycenie barwy żółtej (b*) Yellowness (b*)	–0.225*	0.048	–0.066	–0.171
Szynka – Ham				
pH 45 minut po uboju pH 45 min postmortem	0.117	0.124	–0.166	0.037
pH 24 godziny po uboju pH 24 h postmortem	–0.054	0.063	–0.151	0.011

** Korelacje statystycznie wysoko istotne na poziomie P<0,01. * Korelacje statystycznie istotne na poziomie P<0,05.
** Highly significant correlations at P<0.01.
* Significant correlations at P<0.05.

Discussion

The observed statistical differences for fattening traits among the groups which differ in terms of feed conversion per 1 kg of daily weight gain are indicative of high degree of differentiation of the studied group of animals concerning this trait, and therefore they reflect the possibility of effective breeding work in case of this indicator, which is of particular economic significance during the entire fattening period. The differences in fattening traits observed among the analyzed groups on grounds of the aforementioned division were similar to the differences resulting from daily feed intake (food intake) (Tyra et al., 2019), but they were found among all the analyzed groups (and not only among very different groups as in the case of food intake). However, the exception was daily feed intake, because it was similar for all the groups and ranged from 2.41 kg to 2.52 kg. In previous studies feed conversion efficiency did not have the considerable impact on the previously tested factor, i.e. daily feed intake (food intake) of the studied animals either (Tyra et al., 2019), which might indicate that both analyzed factors of profitability of fattening are conditioned with completely different genetic factors, therefore it would be possible to improve them both at the same time. This is demonstrated by low correlations between these two traits, observed in the authors' own studies and other researchers' studies (Hoque et al., 2007; Gilbert et al., 2007). Favourable relationships were observed between the majority of the analyzed fattening traits and feed conversion ratio per kg of weight gain in favour of the animals with lower ratio (i.e. more efficient in converting feed per weight gain). This is also evidenced by high correlations between these traits, which were observed in the authors' own studies and using data from literature in case of the studied breed (Johnson et al., 1999; Gjerlaug-Enger et al., 2012; Do et al., 2013). Here it is important to note that feed conversion efficiency is conditioned by breed, as evidenced by large breed differences in the observed phenotypic and genetic relationships between the analyzed fattening and slaughter indicators (Schnyder et al., 2002; Gjerlaug-Enger et al., 2012; Do et al., 2013). It follows that, if solely feed conversion per 1 kg of weight gain were taken into account in the selection of Polish Landrace breed, such selection would result in the improvement of many fattening parameters. On the other hand, it would not cause the changes in animal food intake, which is good news in the light of unfavorable changes resulting from the differences in terms of slaughter parameters, which were discussed previously.

In case of the applied free feeding, the excess of obtained fodder (energy) is built up in the form of fat deposits (Faure et al., 2013). In case of own research, the applied division into groups differentiated in terms of feed conversion efficiency (as mentioned earlier) did not diversify the animals in terms of the amount of the obtained fodder, which as a consequence did not have an impact on the increase of fat cover of the obtained carcasses and their primal cuts. This is also confirmed by low correlations between this trait and slaughter traits in case of personal research, not exceeding the level of r = 0.3. Johnson et al. (1999) estimated phenotypic correlations between feed conversion and backfat thickness at a similar level (rP = 0.14), whereas Do et al. (2013) at an even lower level, in case of both phenotypic and genetic correlations (rP = –0.04, rG = –0.03). Several differences, observed in the authors' own studies in terms of slaughter parameters among the groups of animals varied in feed conversion, concerned mainly slaughter traits (loin eye height and area, meat content in primal cuts and carcass meat percentage). The differences were statistically significant ($P \leq 0.01$ and $P \leq 0.05$), despite low correlations observed among these traits. The results are confirmed by the analogous reports of other researchers (Gilbert et al., 2007; Gjerlaug-Enger et al., 2012; Saintilan et al., 2012; Faure et al., 2013). The differences were probably caused by individual predispositions in terms of capacity for protein deposition in the body. Protein deposition in the body is the result of the difference between parallel anabolic and catabolic processes. Research carried out in this area concludes that the level of metabolic energy used to deposit protein is less effective and more diverse than using energy for fat deposition. This is explained by the constant process of rebuilding protein in the body. One example could be the differences in breeds observed in terms of the growth rate of animals representing Pietrain and other breeds, where the animals of the mentioned breed definitely have the slowest growth rate and obtain the highest meatiness (Edwards et al., 2006). According to Fandrejewski (1997) this is precisely the outcome of the differentiation in protein deposition, resulting from the prevalence of catabolic processes in the body.

The discussed indicator (i.e. feed conversion per 1 kg of weight gain) could bring valuable potential (from an economic point of view) if it were introduced to the selection. This is evidenced by the obtained results among very different groups varied according to its size. In the group of animals that converted feed more efficiently, the following were observed: shortening the length of fattening by as many as 12 days, decrease of total feed intake during the fattening period by 40 kg and positive influence on chosen parameters of carcass quality and its most valuable cuts. However, studies by Cleveland and Schinckel (1988) suggest that direct selection for this parameter is not effective. According to the mentioned authors, indirect selection considering daily weight gains brings much better results. This is evidenced by high correlations among these traits observed in the authors' own studies and other researchers' studies (Johnson et al., 1999; Gjerlaug-Enger et al., 2012; Do et al., 2013). Therefore, breeding programmes, which will give great importance to the indicators related with growth rate, will automatically lead to generating the breeding progress in terms of feed conversion improvement per unit of weight gain. This will also contribute to the improvement of many other fattening parameters, which have the influence on the economics of production of slaughter material. The inefficiency of direct selection is the result of low heritability of feed conversion ranging between $h^2 = 0.10$ and $h^2 = 0.29$ (Bereskin, 1986; Schnyder et al., 2002; Cammack et al., 2005; Hoque et al., 2007; Saintilan et al., 2012).

The results of the analyses carried out revealed that the animals representing Polish Landrace breed, which is most often reared in Poland, are characterized by variability in terms of feed conversion efficiency at the level of other fattening indicators (8–9%). This means that within this breed one can isolate sub-groups (sub-populations) of the animals diversified in terms of feed conversion efficiency in the form of body weight gains. Favourable relationships were found between the majority of the analyzed fattening traits and feed conversion ratio per kg of weight gain. The animals that converted feed more efficiently per body weight gain were characterized by more favourable parameters. This is also evidenced by high correlations, which were observed among these traits. The animals with better feed conversion per body weight gain also showed better parameters of carcass meatiness and most valuable cuts.

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Mirosław Tyra, Aurelia Mucha, Robert Eckert

Parameters of fattening performance, slaughter performance and meat quality as related to feed conversion efficiency

summary

The objective of the study was to determine the associations of feed conversion efficiency with fattening traits, slaughter traits and meat quality of pigs, and to determine the correlations between feed conversion per kg weight gain during the different periods of fattening test and selected traits. The experimental material consisted of 122 gilts originating from nucleus herds and performance tested at the Pig Performance Testing Station. As a result of the study, pigs were divided into subgroups according to feed conversion efficiency. Positive relationships were found between most of the analyzed fattening traits and feed conversion (feed: gain ratio). More favourable parameters were observed in animals that converted feed more efficiently ($P \leq 0.01$), as also evidenced by the high correlations between these traits. Animals with better feed conversion also showed better parameters of carcass meatiness and most valuable cuts, but statistically significant differences were only confirmed for loin eye height and area, meat content in primal cuts, and carcass meat percentage ($P \leq 0.05$). For the meat quality traits, the analyzed feed conversion ratio had a significant effect on water holding capacity ($P \leq 0.01$) and yellowness of the meat ($P \leq 0.05$).

Key words: pigs, efficiency of feed conversion, fattening traits, slaughter traits, meat quality