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The effect of genotypes at *loci CAST/Msp*I (calpastatin) and *MYOG* (myogenin) and their interaction on selected productive traits of porkers free of gene *RYR1^T*. I. Muscling and morphological composition of carcass

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The study aimed at determining whether pig carcass traits are significantly related to the genotypes at *loci CAST/Msp*I and *MYOG* and whether an effect exists of interaction between them as regards muscling and morphological traits of carcass. The analyses were conducted on 397 porkers free of gene *RYR1^T* of the five following purebred and crossbred groups: Landrace, Landrace × Yorkshire, Landrace × Duroc, (Landrace × Yorkshire) × Duroc, (Landrace × Yorkshire) × (Duroc × Pietrain) – 91, 65, 129, 83, 29 animals, respectively. Genotype *AA* at *locus CAST/Msp*I occurred to be the most favourable as regards the traits of tenderloin, while genotype *BB* – as regards the traits of ham. Similar relations were observed between the traits of tenderloin or ham and *MYOG* genotype. No significant effect of interaction was identified between the *CAST/Msp*I and *MYOG* genotypes as regards carcass quality traits, but a *CAST* × *MYOG* × sex interaction did prove significant for the weight of ham and shoulder.

KEY WORDS: calpastatin / carcass quality / myogenin / pig / porkers

The porcine carcass and meat quality are traits which affect both the economy of pig production and the effectiveness of technological processing of meat. This points to the necessity of searching for indicators valuable for a suitably directed selection.

The calpain-calpastatin system plays an important role in the normal growth of skeletal muscles during the post-natal period. The active calpain is indispensable for the fusion of myoblasts, proliferation and growth of cells [Melody *et al*. 2004].

The myogenesis processes are controlled, among much else, by four factors from the *MyoD* family. One of those is myogenin, the expression of which is related to the fusion of single nucleus myoblasts into poly-nuclei muscle fibres [Te Pas and Visscher 1994]. During the post-natal period, the MYOG transcripts are cumulated principally within muscle regions dominated by slow contracting fibres, *i.e*. of an oxidative character [Voytik *et al*. 1993].

The study presented here aimed at evaluating the effect of the porker's genotype at *loci MYOG* and *CAST* on carcass traits as well as at estimating the interaction possibly existing between them in relation to the traits examined in porkers free of gene $RYR1^T$.

Material and methods

Animals

The investigation covered 397 porkers, including purebred Landrace, and the following crossbred pigs: Landrace × Yorkshire, Landrace × Duroc, (Landrace × Yorkshire) × Duroc, and (Landrace × Yorkshire) × (Duroc × Pietrain) – 91, 65, 129, 83 and 29 animals, respectively, all free of gene $RYR1^T$.

Relations examined

Within 24 h post-slaughter the morphological composition of carcass was assessed together with the muscle deposition (Tab. 1), according to the method applied in the Polish Pig Slaughter Performance Testing Stations (SKURTCh) – Różycki [1996]. Slaughter quality traits were analysed on the basis of data standardized for hot carcass weight 85 kg. The standardization was performed separately for each of five genetic groups.

The genomic DNA was isolated from blood leukocytes according to Kawasaki [1990]. Genotypes *CAST/Msp*I and *MYOG* were identified by the PCR/RFLP method, according to Ernst *et al*. [1998] and Soumillion *et al*. [1997], respectively.

The *AA* genotype at *MYOG locus* was not found in pigs considered. The remaining genotypes at *locus MYOG* (*AB, BB*) and all three genotypes of *CAST*/*Msp*I *locus* (*AA, AB, BB*) were present in all genetic groups analysed.

Statistical

The effects of genotypes *CAST* and *MYOG,* as well as of sex on the muscle deposition and morphological composition of carcasses were estimated using a three-factor analysis of variance in an non-orthogonal arrangement. The statistical model comprised *CAST* and *MYOG* genes polymorphism, sex and their interactions, as follows:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + ab_{ij} + ac_{ik} + bc_{jk} + abc_{ijk} + e_{ijkl}$$

where:

Y_{ijkl} – the carcass quality trait;

μ – the overall mean;

a_i – the effect of *CAST* genotype, i = 1,2,3;

b_j – the effect of *MYOG* genotype, j =1,2;

c_k – the effect of sex, k =1,2;

ab_{ij} – the effect of interaction between *CAST* and *MYOG* genotypes;

ac_{ik} – the effect of interaction between *CAST* genotype and sex;

bc_{jk} – the effect of interaction between *MYOG* genotype and sex;

abc_{ijk} – the effect of interaction between *CAST* and *MYOG* genotypes and sex;

e_{ijkl} – the random error.

The significance of differences between means was identified with the NIR test [STATISTICA 1997, PL 5.1].

Results and discussion

Out of 19 carcass quality traits of porkers 13 appeared significantly more favourable in gilts than in castrated males, what is in accordance with the common opinion. Backfat thickness was, at all measurement points, significantly smaller in gilts than in castrated males. Meat content of carcass and weight of ham and meat of ham was higher in gilts than in castrates (Tab. 1).

The effect of the *CAST/Msp*I genotype on muscling and morphological composition of carcass

Among the 19 traits characterizing carcass quality, the values of five were significantly or highly significantly related to the *CAST/Msp*I genotype (Tab. 1). The weight of tenderloin and tenderloin without skin and fat, as well as the weight of shoulder, were significantly higher in animals with genotype *AA* than in those with genotype *BB*. In turn, the weight of ham in *BB* was significantly higher than in *AA* animals. Moreover, heterozygotes demonstrated the thinnest fat over the shoulder ($P \leq 0.05$).

It is known, that the proteolytic calpain-calpastatin system participates in the processes of muscle growth and development [Goll *et al*. 1998, a review]. The present study indicates that the rate of those processes may be dependent on the *CAST* genotype. This would indicate the feasibility of differentiating the activity of calpastatin as a calpain inhibitor, depending on its genetic variant. One of the calpastatin variants proved to be more favourable for the weight of the tenderloin, while the other for the weight of ham. Thus, one could conclude about a different effect of the molecular

Table 1. Effect of *CAST/Msp*I gene, *MYOG* gene, sex and their interactions on carcass composition traits

Trait	*CAST/Msp*I				*MYOG*			Sex			Interaction – $F_{emp.}$			
	AA (n=100)	*AB* (n=163)	*BB* (n=134)	$F_{emp.}$	*AB* (n=141)	*BB* (n=256)	$F_{emp.}$	castrates (n=211)	gilts (n=186)	$F_{emp.}$	1	2	3	4
Lean meat content (%)	56.42 ±2.38	56.52 ±2.44	56.44 ±2.37	0.37 ns	56.61 ±2.36	56.39 ±2.41	1.01 ns	55.81^{a} ±2.41	57.21^{b} ±2.15	**37.47** **	0.42 ns	2.30 ns	0.00 ns	0.42 ns
Backfat thickness over the shoulder (cm)	3.12^{b} ±0.41	3.04^{a} ±0.51	3.12^{b} ±0.48	**3.15** *	3.08 ±0.41	3.09 ±0.51	0.06 ns	3.17^{b} ±0.49	2.99^{a} ±0.44	**13.41** **	2.32 ns	1.56 ns	0.83 ns	0.38 ns
Backfat thickness over the last rib (cm)	1.43 ±0.46	1.36 ±0.37	1.38 ±0.46	0.07 ns	1.32^{a} ±0.39	1.42^{b} ±0.44	**7.64** **	1.46^{b} ±0.39	1.29^{a} ±0.45	**16.70** **	2.08 ns	2.96 ns	0.64 ns	0.88 ns
Backfat thickness over the I cross (cm)	1.89 ±0.37	1.92 ±0.37	1.97 ±0.40	2.78 ns	1.91 ±0.38	1.93 ±0.38	0.26 ns	2.02^{b} ±0.38	1.80^{a} ±0.34	**30.75** **	0.25 ns	0.23 ns	0.08 ns	0.46 ns
Backfat thickness over the II cross (cm)	1.40 ±0.32	1.40 ±0.31	1.46 ±0.35	2.59 ns	1.43 ±0.35	1.41 ±0.31	0.01 ns	1.51^{b} ±0.33	1.32^{a} ±0.29	**34.73** **	0.84 ns	1.08 ns	0.12 ns	0.03 ns
Backfat thickness over the III cross (cm)	2.26 ±0.41	2.27 ±0.45	2.31 ±0.45	1.44 ns	2.31 ±0.44	2.26 ±0.44	0.93 ns	2.42^{b} ±0.43	2.12^{a} ±0.40	**40.23** **	0.11 ns	0.16 ns	0.85 ns	0.05 ns
Mean backfat thickness from 5 measurements (cm)	2.03 ±0.30	2.00 ±0.27	2.05 ±0.30	1.82 ns	2.01 ±0.28	2.02 ±0.30	0.60 ns	2.12^{b} ±0.27	1.91^{a} ±0.26	**56.34** **	1.08 ns	1.58 ns	0.71 ns	0.04 ns
Tenderloin eye area (cm^2)	51.57 ±5.76	52.50 ±5.97	51.55 ±5.77	0.57 ns	51.54 ±5.50	52.17 ±6.04	0.11 ns	51.84 ±6.20	52.07 ±5.45	1.28 ns	1.12 ns	2.74 ns	0.01 ns	2.47 ns
Carcass length (cm)	81.34 ±2.54	82.32 ±2.78	82.58 ±2.81	1.54 ns	81.67 ±2.82	82.46 ±2.67	1.31 ns	81.39^{a} ±2.26	82.56^{b} ±2.94	**4.38** *	1.20 ns	0.01 ns	2.00 ns	0.96 ns
Tenderloin weight (kg)	8.64^{b} ±0.65	8.52^{ab} ±0.73	8.41^{a} ±0.67	**4.64** *	8.45 ±0.78	8.55 ±0.64	1.89 ns	8.51 ±0.68	8.51 ±0.72	0.21 ns	1.81 ns	0.50 ns	2.16 ns	0.71 ns
Tenderloin weight without fat and skin (kg)	6.48^{b} ±0.56	6.40^{ab} ±0.63	6.27^{a} ±0.57	**5.00** **	6.30^{a} ±0.65	6.42^{b} ±0.56	**3.99** *	6.33 ±0.58	6.43 ±0.61	1.84 ns	0.68 ns	1.65 ns	2.29 ns	0.74 ns

Table 1. Continued.

Trait	*CAST/Msp*I				*MYOG*			Sex			Interaction – $F_{emp.}$			
	AA (n=100)	*AB* (n=163)	*BB* (n=134)	$F_{emp.}$	*AB* (n=141)	*BB* (n=256)	$F_{emp.}$	castrates (n=211)	gilts (n=186)	$F_{emp.}$	1	2	3	4
LD muscle weight (kg)	2.90 ±0.28	2.94 ±0.33	2.91 ±0.36	0.12 ns	2.85^{a} ±0.29	2.96^{b} ±0.34	**7.81** **	2.91 ±0.28	2.94 ±0.37	0.27 ns	1.77 ns	1.82 ns	**4.81** *	1.73 ns
Ham weight (kg)	10.25^{a} ±0.37	10.26^{a} ±0.57	10.40^{b} ±0.64	**3.90** *	10.46^{b} ±0.61	10.22^{a} ±0.51	**16.34** **	10.24^{a} ±0.51	10.38^{b} ±0.60	**8.28** **	1.98 ns	3.83 ns	3.80 ns	**3.15** *
Ham weight without fat and skin (kg)	8.51 ±0.84	8.58 ±0.86	8.58 ±0.91	0.59 ns	8.66^{b} ±0.52	8.50^{a} ±0.45	**10.99** **	8.46^{a} ±0.44	8.66^{b} ±0.50	**19.16** **	2.20 ns	3.42 ns	1.09 ns	1.87 ns
Ham muscles weight (kg)	7.60 ±0.40	7.62 ±0.44	7.66 ±0.49	1.93 ns	7.75^{b} ±0.43	7.56^{a} ±0.44	**14.65** **	7.55^{a} ±0.43	7.72^{b} ±0.44	**17.66** **	3.57 ns	3.80 ns	1.33 ns	2.92 ns
Neck weight (kg)	5.40 ±0.44	5.43 ±0.48	5.38 ±0.44	0.29 ns	5.41 ±0.41	5.40 ±0.48	0.01 ns	5.41 ±0.47	5.40 ±0.43	0.03 ns	2.86 ns	2.49 ns	2.31 ns	1.21 ns
Shoulder weight (kg)	6.08^{b} ±0.37	6.06^{b} ±0.39	5.93^{a} ±0.36	**7.07** **	6.05 ±0.40	6.00 ±0.38	2.87 ns	6.02 ±0.41	6.02 ±0.35	0.03 ns	2.06 ns	0.09 ns	0.33 ns	**4.04** *
Belly weight (kg)	6.46 ±0.57	6.59 ±0.59	6.67 ±0.65	1.35 ns	6.47^{a} ±0.64	6.64^{b} ±0.59	**5.96** *	6.69^{b} ±0.59	6.46^{a} ±0.61	**14.90** **	2.46 ns	1.38 ns	1.10 ns	1.18 ns
Primary cuts weight (kg)	23.41 ±0.92	23.35 ±1.00	23.33 ±1.01	0.17 ns	23.46 ±0.95	23.31 ±1.00	2.40 ns	23.12^{a} ±0.98	23.63^{b} ±0.92	**27.66** **	0.44 ns	1.85 ns	0.00 ns	0.67 ns

1 – *CAST/Msp*I × *MYOG*; 2 – *CAST/Msp*I × sex; 3 – *MYOG* × sex; 4 – *CAST/Msp*I × *MYOG* × sex.
$^{aA...}$Means within rows and genotypes bearing different superscripts differ significantly at: small letters – P≤0.05; capitals – P≤0.01.
***P≤0.05; **P≤0.01**; ns – not significant.

calpastatin variants as calpain inhibitors depending on the muscle type (white muscles – tenderloin, red muscles – ham muscles).

The effect of the *MYOG* genotype on muscling and morphological composition of carcass

The value of seven out of 19 carcass traits analysed in this study was found to depend significantly or highly significantly on the porker's genotype at *locus MYOG*. The backfat over the last vertebra appeared highly significantly thicker and the weight of belly greater (by 0.17 kg, $P \leq 0.05$) in homozygotes *BB* than in heterozygotes. Moreover, homozygotes *BB* demonstrated a higher weight of tenderloin without fat and skin and of *longissimus dorsi* (LD) muscle than did heterozygotes. In turn, the weight of ham, ham without fat and skin and of ham muscles was higher in heterozygotes *AB* than in *BB* homozygotes (Tab. 1).

In the literature only the relation between carcass traits and the genotype of pigs at *locus MYOG* has been indicated. Te Pas *et al*. [1999] demonstrated that those with genotype *BB* show a significantly higher meat content of carcass than animals with genotype *AA* or *AB* (calculated on the basis of an ultrasonic measurement of backfat thickness at 5 points over the back, at even distances between the shoulder and last vertebra). Moreover, Te Pas *et al*. [1999] indicate that the genotype *MYOG* was not related to the fat thickness at different measurement points, what they considered as obvious, due to the fact that the expression of *MYOG* takes place only in the muscle and not in the fat tissue. However, Cieślak *et al*. [2002] demonstrated a significant relation between the backfat thickness at different points of measurement and the *MYOG* genotype. The results presented here point to a similar relationship between the backfat thickness over the last vertebra and weight of belly. Myogenin is a transcription factor regulating the expression of genes of muscle-specific proteins and is one of the regulators of myogenesis. At present it is still difficult to indicate the mechanism of the effect of myogenin on the deposition of fat tissue. However, as similar relations were observed in independent studies and on different material, one should take them into consideration in future investigations.

Moreover, it has been demonstrated that the weight of tenderloin without fat and skin and the weight of the LD muscle were significantly higher in porkers of genotype *BB* and *AB*, what is compliant with the conclusion presented by Te Pas *et al*. [1999], that genotype *BB* is more favourable for muscle deposition in the carcass. However, another observation made in this work, indicating that the weight of ham muscles is higher in porkers of genotype *AB* than *BB*, does not confirm that conclusion. Thus, one could suggest that the effect of the *MYOG* genotype on the weight of the most important carcass cuts depends on the muscle type (white *vs*. red muscles). Voytik *et al*. (1993) demonstrated that the expression of the myogenin gene in mice was the highest in muscles with a high share of slow-twich oxidative (STO) fibres. The relation between the *MYOG* genotype and the muscle weight may be closely affected by metabolic type of fibres.

Wyszyńska-Koko *et al.* [2006] demonstrated the association between the mutation in the 3'-flanking region of the *MYOG* gene and production traits in pigs – loin weight, and loin eye height and area in Polish Landrace, and also ham weight and meat content of carcass in Polish Large White.

Effect of interaction between the *CAST/Msp*I and *MYOG* genotypes and sex on muscling and carcass morphological composition

No significant effect was observed of interaction between the *CAST/Msp*I and *MYOG* genotypes on the carcass traits analysed. However, a significant *MYOG* × sex interaction was found as regards the weight of the LD muscle (Tab. 1). The trait was independent of the *MYOG* genotype in castrated males, but gilts of genotype *BB* showed LD by 0.2 kg heavier than those of *AB* genotype (Fig. 1).

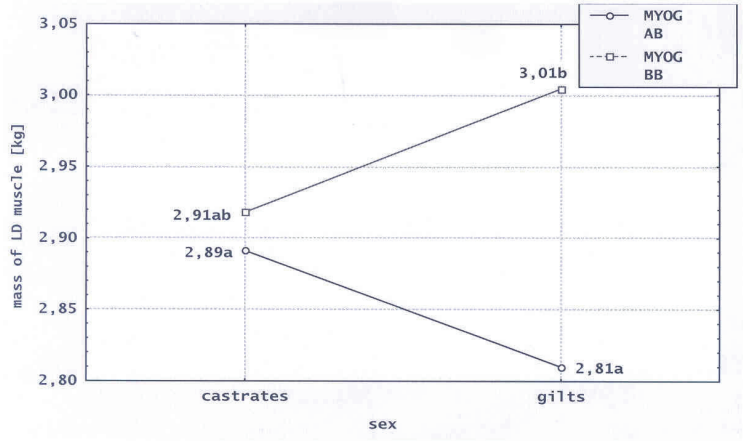

Fig. 1. Interaction between *MYOG* genotype and sex of animals for weight of LD muscle.
a, b – means shown on the plot, marked by different small letters differ significantly at P≤0.05

The weight of ham and shoulder both depended on the combination of genotype *MYOG* and *CAST/Msp*I, as well as on the animal's sex (Tab. 1). It appears that the higher weight of ham is determined by genotype *AB* at *locus MYOG*, independently of the genotype at *locus CAST/Msp*I or sex (Tab. 2). However, the highest weight of ham (10.96 kg) was observed in gilts of genotype *AB* at *locus MYOG* and *BB* at *locus CAST/Msp*I (Fig. 2). Compared to the values recorded for porkers with genotype *BB* at *locus MYOG* the difference amounted to 0.8 kg, almost reaching the value of standard deviation.

For those groups of porkers with individual combinations of genotype *MYOG*, *CAST/Msp*I and sex, which differed significantly in the weight of ham, an additional comparative analysis was performed for the remaining carcass traits (Tab. 2). It was observed that gilts of genotypes *AB* or *BB* at *loci MYOG* and *CAST/Msp*I, respectively,

Table 2. The characteristic of peripheral subgroups of 3-way interaction between *CAST/Msp*I and *MYOG* genes and sex of fatteners for weight of ham

Trait	*MYOG BB*; *CAST/Msp*I *AA* castrates (n=29)	*MYOG BB*; *CAST/Msp*I *AB* castrates (n=69)	*MYOG BB*; *CAST/Msp*I *AB* gilts (n=40)	*MYOG AB*; *CAST/Msp*I *AA* gilts (n=25)	*MYOG AB*; *CAST/Msp*I *AB* castrates (n=29)	*MYOG AB*; *CAST/Msp*I *BB* gilts (n=24)	$F_{emp.}$
Ham weight (kg)	10.16^{A} ±0.38	10.18^{A} ±0.58	10.14^{A} ±0.51	10.49^{B} ±0.64	10.41^{B} ±0.47	10.96^{C} ±0.86	**8.38** **
Lean meat content (%)	55.32^{A} ±2.10	56.06^{AB} ±2.70	57.03^{BC} ±2.12	57.09^{BC} ±2.35	56.44^{AB} ±2.14	57.75^{C} ±2.37	**3.95** **
Backfat thickness over the last rib (cm)	1.61^{B} ±0.40	1.40^{A} ±0.35	1.35^{A} ±0.39	1.25^{A} ±0.47	1.36^{A} 0.33	1.26^{A} ±0.42	**3.30** **
Backfat thickness over the I cross (cm)	1.98^{BC} ±0.40	2.04^{C} ±0.34	1.75^{A} ±0.36	1.79^{AB} ±0.37	1.95^{BC} ±0.34	1.85^{AB} ±0.36	**4.19** **
Backfat thickness over the II cross (cm)	1.48^{BC} ±0.28	1.46^{BC} ±0.29	1.28^{A} ±0.30	1.32^{AB} ±0.29	1.52^{C} ±0.35	1.33^{AB} ±0.26	**3.79** **
Backfat thickness over the III cross (cm)	2.39^{B} ±0.43	2.40^{B} ±0.44	2.07^{A} ±0.40	2.12^{A} ±0.46	2.38^{B} ±0.43	2.22^{AB} 0.44	**4.43** **
Mean backfat thickness from 5 measurements (cm)	2.14^{C} ±0.26	2.09^{BC} ±0.26	1.89^{A} ±0.27	1.89^{A} ±0.27	2.03^{BC} ±0.23	1.95^{B} ±0.24	**5.88** **
Tenderloin eye muscle area (cm^2)	49.89^{a} ±5.51	53.68^{b} ±6.87	51.71^{ab} ±4.70	51.98^{ab} ±6.05	51.29^{ab} ±4.81	50.08^{a} ±4.38	**2.62** *
Ham weight without fat and skin (kg)	8.42^{A} ±0.42	8.45^{AB} ±0.47	8.51^{AB} ±0.43	8.70^{B} ±0.49	8.60^{AB} ±0.42	9.04^{C} ±0.76	**6.19** **
Ham muscles weight (kg)	7.46^{A} ±0.43	7.55^{AB} ±0.46	7.60^{AB} ±0.42	7.78^{B} ±0.43	7.68^{AB} ±0.38	8.21^{C} ±0.42	**8.17** **
Tenderloin weight (kg)	8.63^{b} ±0.60	8.45^{b} ±0.74	8.65^{b} ±0.53	8.42^{b} ±0.93	8.61^{b} ±0.78	8.07^{a} ±0.75	**2.50** *
Tenderloin weight without fat and skin (kg)	6.42^{b} ±0.47	6.31^{ab} ±0.61	6.58^{b} ±0.57	6.35^{b} ±0.74	6.40^{b} ±0.62	6.02^{a} ±0.65	**2.75** *
LD muscle weight (kg)	2.87^{AB} ±0.26	2.97^{B} ±0.31	3.06^{B} ±0.38	2.73^{A} ±0.34	2.89^{AB} ±0.23	2.79^{A} ±0.41	**3.60** **
Belly weight (kg)	6.56^{B} ±0.63	6.71^{B} ±0.48	6.54^{B} ±0.63	6.36^{AB} ±0.65	6.58^{B} ±0.68	6.10^{A} ±0.49	**3.39** **
Primary cuts weight(kg)	23.04^{A} ±0.87	23.15^{A} ±1.09	23.50^{AB} ±0.94	23.61^{B} 0.87	23.41^{AB} ±0.88	23.92^{B} 1.14	**3.24** **

$^{aA...}$Means within rows bearing different superscripts differ significantly at: small letters – P≤0.05; capitals – P≤0.01.
***P≤0.05; **P≤0.01.**

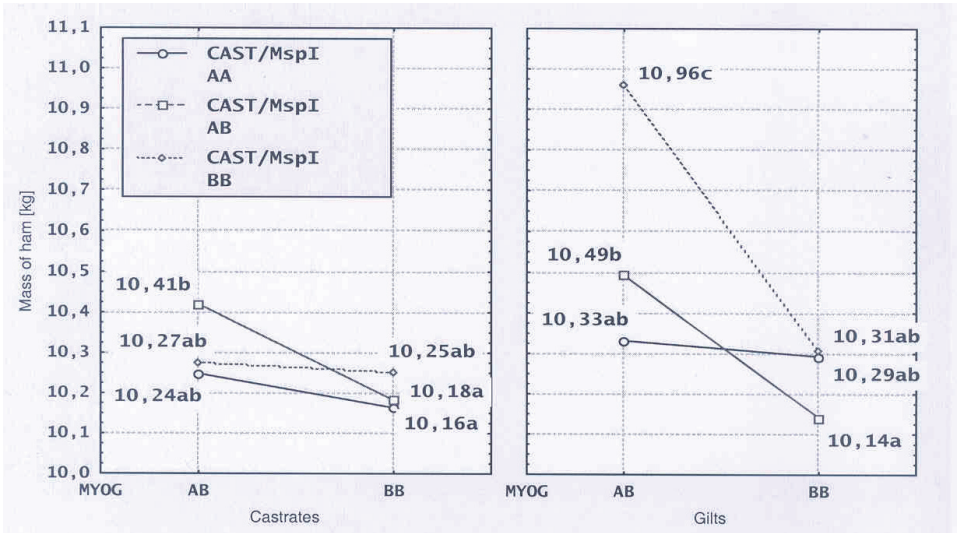

Fig. 2. Interaction between genotypes *CAST/Msp*I and *MYOG* and sex of fatteners for weight of ham. a, b, c – means shown on the plot, marked by different small letters differ significantly at P≤0.05.

Table 3. The characteristic of peripheral subgroups of 3-way interaction between *CAST/Msp*I and *MYOG* genes and sex of fatteners for weight of shoulder

Trait	*MYOG BB*; *CAST/Msp*I *BB* castrates (n=35)	*MYOG AB*; *CAST/Msp*I *BB* gilts (n=22)	*MYOG AB*; *CAST/Msp*I *AA* castrates (n=16)	*MYOG AB*; *CAST/Msp*I *AA* gilts (n=15)	F emp.
Shoulder weight (kg)	5.83^{A} ±0.37	5.82^{A} ±0.27	6.22^{B} ±0.33	6.19^{B} ±0.44	**7.43** **
Lean meat content (%)	55.50^{A} ±2.42	57.75^{B} ±2.37	55.46^{A} ±2.36	57.33^{B} ±2.07	**6.37** **
Backfat thickness over the last rib (cm)	1.62^{B} ±0.47	1.26^{A} ±0.42	1.33^{A} ±0.29	1.21^{A} ±0.31	**6.12** **
Backfat thickness over the I cross(cm)	2.08^{b} ±0.44	1.85^{ab} ±0.36	1.94^{ab} ±0.35	1.75^{a} ±0.35	**3.34** *
Backfat thickness over the II cross (cm)	1.58^{B} ±0.37	1.33^{AB} ±0.26	1.43^{AB} ±0.37	1.28^{A} ±0.34	**4.20** **
Mean backfat thickness from 5 measurements (cm)	2.20^{B} ±0.31	1.95^{A} ±0.24	2.05^{AB} 0.24	1.88^{A} ±0.28	**6.54** **

$^{aA...}$Means within rows bearing different superscripts differ significantly at: small letters – P≤0.05; capitals – P≤0.01.
***P≤0.05; **P≤0.01**.

characterized, as earlier mentioned, by the highest weight of ham, demonstrated also the highest weight of the dissection elements of ham (fat, skin and meat), the highest weight of the basic cuts and the highest meat amount of carcass, estimated according to the method used at Polish Pig Slaughter Performance Testing Stations. Simultaneously, the weight of tenderloin, tenderloin without fat and skin, weight of the LD muscle and weight of belly were the lowest in those animals. Relating to the measurements of backfat thickness at different carcass points, it is difficult to indicate univocally a most favourable, universal combination of genotypes *MYOG* with *CAST/Msp*I and sex.

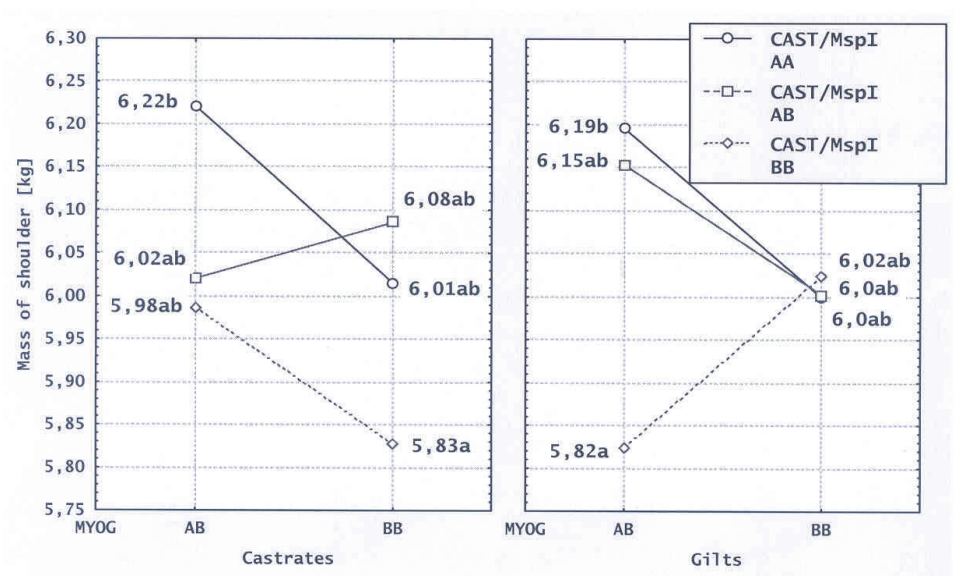

Fig. 3. Interaction between genotypes *CAST/Msp*I and *MYOG* and sex of fatteners for weight of shoulder.
a, b, c – means shown on the plot, marked by different small letters differ significantly at P≤0.05.

An interaction between genotypes *MYOG*, *CAST/Msp*I and sex has been confirmed statistically (P≤0.05) also for the weight of shoulder (Tab. 3). Porkers of both sexes and genotypes *AB* and *AA* at *locus MYOG* and *CAST/Msp*I, respectively, demonstrated a higher weight of shoulder (by about 0.40 kg) than animals with genotype *BB* at *locus CAST/Msp*I and either of the remaining *MYOG* genotypes (Fig. 3). Significant differences between them were recorded for five traits, principally the backfat thickness at various measurement points (Tab. 3).

The study presented here confirmed that carcass quality traits are an effect of various genes, and that the effect of individual genes varies and depends on a combination of genotypes at the *loci* analysed within the whole genotype of the animal. Despite a lack

of literature data one may state that the interaction demonstrated between genotypes *CAST/Msp*I and *MYOG* determines the developmental differentiation of individual parts of the carcass.

The presented results can be summarized as follows.

Genotype *AA* at *locus CAST/Msp*I is more favourable for the weight of tenderloin, while genotype *BB* – for the weight of ham. Similarly, a higher weight of tenderloin is determined by genotype *BB* at *locus MYOG*, while a higher weight of ham is observed in carriers of allele *A* of this gene.

No significant interaction was identified between genotypes *CAST/Msp*I and *MYOG* for carcass quality traits. However, a *CAST* × *MYOG* × sex interaction did prove significant for the weight of ham and shoulder. The *AA* and *BB* combination of genotypes *MYOG* and *CAST/Msp*I, respectively, proved to be most favourable for the improvement of the weight of ham in gilts.

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Cechy produkcyjne tuczników wolnych od genu *RYR1^T* oceniane zależnie od genotypu względem *loci CAST/Msp*I (kalpastatyny) i *MYOG* (miogeniny). I. Mięsność i skład morfologiczny tuszy

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

Celem badań było określenie, czy cechy tuszy świń są istotnie zależne od genotypu względem *loci CAST*/*Msp*I i *MYOG* oraz czy istnieje współdziałanie między tymi *loci* w zakresie kształtowania badanych cech. Badania przeprowadzono na 397 tucznikach wolnych od genu *RYR1^T*, następujących ras czystych i ich mieszańców: landrace, landrace × yorkshire, landrace × duroc, (landrace x yorkshire) × duroc i (landrace × yorkshire) × (duroc × pietrain) – odpowiednio 91, 65, 129, 83 i 29 zwierząt. Genotyp *AA* względem *locus CAST*/*Msp*I okazał się najkorzystniejszy dla cech polędwicy, podczas gdy genotyp *BB* – dla cech szynki. Podobne zależności odnotowano między cechami polędwicy i szynki a genotypem *MYOG*. Nie stwierdzono istotnej interakcji między genotypami *CAST*/*Msp*I a *MYOG* dla cech jakości tuszy, podczas gdy interakcja *CAST* × *MYOG* × płeć okazała się istotna dla masy szynki zadniej i masy łopatki.