

Effect of *colipase* Gene (*CLPS*) Polymorphism on Carcass and Meat Quality in Pigs

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The study covered 110 crossbred fatteners [σ Pietrain \times (φ Polish Large White \times Polish Landrace)], reared in standard conditions and slaughtered at an average body weight of 105 kg. Carcasses were tested in accordance with the method used in the Polish Pig Testing Station. The study evaluated the quality of carcass and meat of pigs depending on *colipase* gene (*CLPS*). A significant effect on some characteristics connected with lean content of the carcass was shown as well as on fat content. No statistically significant differences were shown in relation to the features of the meat quality.

Key words: Pigs, *colipase* gene, carcass, meat quality.

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Reduction of fat content of carcasses and improvement of their meatiness, maintaining a proper level of technological usefulness and taste of acquired pork is a leading problem of pig breeding today.

Searching for DNA (gene) regions responsible for shaping quantitative traits of animal carcasses (QTLs) has become an important task for molecular genetics as well as practical breeding. The *colipase* gene (*CLPS*) belongs to the gene group of so called candidate genes. The *CLPS* gene was located in the area of chromosome 7 (BASKIN & POMP 1998), just like other genes of quantitative traits (QTLs) that can have an effect on fat content of animals (ROTHSCHILD *et al.* 1995; WANG *et al.* 1998).

The aim of the study was to determine the influence of polymorphic forms of *colipase* gene (*CLPS*) on performance of pigs in the scope of the quality of carcass and meat.

Material and Methods

The experiment was carried out on 110 crossbred fatteners [σ Pietrain \times (σ Polish Large White \times Polish Landrace)]. Pigs were reared in

standard conditions. In the course of fattening blood samples were taken from the vena cava in order to determine the *colipase* genotype, using the PCR/RFLP method (BASKIN & POMP 1998). The fatteners were slaughtered as soon as they reached about 105 kg of body weight.

Meat quality traits were measured in the *longissimus lumborum* muscle. In about 45 minutes after slaughter the meat was measured for pH₁ value using a pistol pH-meter (Matthäus). After 24-hour cooling, the right half carcasses were divided using the methods applied for the Polish Pig Testing Station (SKURTCh) (RÓŻYCKI 1996). Thickness of the back fat was measured in five points: above the shoulder, between the last thoracic vertebra and the first lumbar vertebra and at the level of sacral vertebra – I, II, III. The length of the carcasses was also determined.

In about 48 hours after slaughter the physico-chemical evaluation of meat was carried out. The measurement of meat covered: ultimate pH (pH_u), color lightness on Spekol 11 (RÓŻYCZKA *et al.* 1968), water holding capacity (WHC) by the method of GRAU and HAMM (1952), drip loss (HONIKEL 1987). The meat was assayed for its basic chemical composition, i.e. protein, fat, water content, according to methods by AOAC (1990).

Table 1

Slaughter value of carcasses in relation to the *colipase* gene

Trait	CLPS genotype		
	AA	AB	BB
Number (n)	38	62	10
Carcass length (cm)	81.08 ± 1.68	81.45 ± 1.53	81.30 ± 1.64
Slaughter yield (%)	80.30 ± 2.40	80.19 ± 1.75	80.18 ± 1.88
Carcass lean content (%)	51.60 ± 3.85	52.53 ± 3.54	51.96 ± 3.81
Loin eye area (cm ²)	43.65 ± 5.51	43.67 ± 5.40	43.10 ± 5.36
Neck weight (kg)	5.13 ^A ± 0.37	5.04 ± 0.35	4.80 ^B ± 0.29
Meat in neck (kg)	3.36 ^A ± 0.29	3.28 ^A ± 0.22	3.04 ^B ± 0.17
Backfat thickness (cm)			
over shoulder	3.70 ± 0.49	3.63 ± 0.58	3.78 ± 0.93
over last rib	2.53 ± 0.48	2.49 ± 0.50	2.70 ± 0.44
over sacrum I	3.00 ^b ± 0.50	3.03 ± 0.57	3.37 ^a ± 0.78
over sacrum II	2.21 ± 0.51	2.26 ± 0.58	2.41 ± 0.62
over sacrum III	3.06 ^b ± 0.45	3.20 ± 0.63	3.52 ^a ± 0.89
Average of 5 measurements (cm)	2.90 ± 0.43	2.91 ± 0.52	3.16 ± 0.70

Significance of differences: A, B – $P \leq 0.01$ Significance of differences: a, b – $P \leq 0.05$

Table 2

The physicochemical traits of meat in relation to the *colipase* genotype

Trait	CLPS genotype		
	AA	AB	BB
pH _i	6.33 ± 0.44	6.24 ± 0.46	6.41 ± 0.35
pH _u	5.52 ± 0.13	5.51 ± 0.12	5.41 ± 0.17
Color lightness, %	22.08 ± 3.39	23.57 ± 3.84	22.71 ± 2.77
WHC, loose water %	19.90 ± 2.79	20.26 ± 2.87	20.11 ± 2.73
Drip loss, %	3.77 ± 2.75	4.27 ± 2.60	2.89 ± 1.44
Chemical analysis			
Water content, %	74.40 ± 0.82	74.36 ± 0.83	74.29 ± 0.70
Protein content, %	23.43 ± 0.54	23.43 ± 0.69	23.28 ± 0.60
Intramuscular fat content, %	1.03 ± 0.43	1.04 ± 0.44	0.88 ± 0.29

In order to compile the results, the computer program STATISTICA 5.5 PL (2000) was used. Differences between groups were defined using single-factor analysis of variances and significance by means of the Duncan test.

Results and Discussion

Table 1 shows the number of pigs with different *colipase* gene status and selected data describing carcass characteristics of pigs. The homozygous *BB* genotype pigs were the least numerous, only 10 versus 38 *AA* and 62 *AB*. There is a significant influence of *colipase* gene polymorphism as regards traits connected with neck weight and meat con-

tent in that cut. Animals with the *AA* genotype were distinguished by a much higher neck weight (5.13 kg) in comparison with *BB* pigs (4.80 kg); $P \leq 0.01$. Moreover group *BB* had a significantly lower content of meat in that cut (3.04 kg) in comparison with other groups (3.28 kg in *AB* group and 3.36 kg in *AA* group); $P \leq 0.01$. Similar results were obtained by KURYŁ *et al.* (2001).

The percentage content of meat in carcasses was at a similar level in all three genotype groups of studied animals and amounted in average to 52%. Also BLICHARSKI *et al.* (2004) did not find any significant differences in the carcass lean content in respect to *CLPS* genotype in PLW pigs.

The study also showed the influence of polymorphism of the *CLPS* gene on fat content of car-

casses. Significant differences were also registered in case of thickness of back fat measured over the first and third sacrum. In animals with the *BB* genotype (3.37 cm and 3.52 cm) back fat was thicker than in *AA* pigs (3.00 cm and 3.06 cm); $P \leq 0.05$, which was also described in the paper of KURYŁ *et al.* (2001).

These studies did not show a significant influence of *colipase* gene polymorphism in the scope of meat quality traits (Table 2). One of the most important physicochemical parameters determining meat quality is pH. The level of acidification of muscle tissue during the first hour after slaughter (pH_1) differed in the studied groups of pigs but with no essential statistical differences. Lower acidity of meat was observed in case of the *BB* genotype (6.41) in comparison to *AA* (6.33) and *AB* (6.24). The acidity of meat measured 48 hours after slaughter (pH_{48}) averaged for particular groups between 5.41 and 5.52. These values are typical for normal meat.

An important element of meat quality evaluation and its technological usefulness is the ability to hold a specified amount of water (water holding capacity) as well as drip loss. The values of these traits obtained by studied crossbreds were typical for the normal meat of great culinary and technological usefulness.

The basic chemical composition of the meat, deciding about the nutritional value of food products, showed no relevant statistical differences between genotype groups of pigs. The meat of the examined animals had a similar chemical content as regards both water and protein content. There were small differences in respect of intramuscular fat content. The lowest intramuscular fat content was registered in the meat of animals with *CLPS BB* genotype (0.88 %), and the highest in heterozygotes (1.04 %), although these differences were not statistically significant. Different results were obtained by Blicharski *et al.* (2004) – *BB* individuals (1.07 %), *AB* (1.13 %), whereas the meat of *AA* fatteners contained the highest intramuscular fat content (1.18 %).

The presented results of the study conducted on crossbreds P x (PLW x PL) with regard to *CLPS* genotype showed an essential influence on fat content of carcass, first of all in relation to the thickness of back fat measured in two points, over the first and third sacrum. The differences were statistically significant. The values of characteristics connected with lean content of carcass were at a satisfactory level. The study indicated an essential influence of *colipase* gene polymorphism on some estimated traits. At the same time predictions regarding the influence of the examined gene on meat quality were not confirmed.

References

- AOAC 1990. Official Methods of Analysis 15 th ed. Association of Official Analytical Chemists.
- BASKIN L. C., POMP D. 1998. Mapping of the porcine colipase gene to chromosome 7 using linkage analysis. *J. Anim. Sci.* **76**: 1241-1242.
- Blicharski T., Kurył J., Pierzchała M. 2004. Relationship between polymorphism at *loci* colipase and leptin and most important fattening and slaughter traits in pigs with special reference to intramuscular fat – a review. *Prace & Mat. Zoot., Zesz. Spec.* **15**: 41-46. (In Polish).
- GRAU R., HAMM R. 1952. Eine einfache Methode zur Bestimmung der Wasserbindung im Fleisch. *Fleischwirtschaft* **4**: 295-297.
- HONIKEL K. O. 1987. The water binding of meat. *Fleischwirtschaft* **67**: 1098-1102.
- Kurył J., Pierzchała M., Kapelański W., Bocian M., Grajewska S. 2001. Polymorphism of GH, LEP, COL, LIPE genes in choosen breeds of pigs breded in Poland and his influence on quality of carcass. XIV Conf. PTG – Poznań, **63**. (In Polish).
- ROTHSCHILD M. F., LIU H.-C., TUGGLE C. K., YU T.-P., WANG L. 1995. Analysis of pig chromosome 7 genetic markers for growth and carcass performance traits. *J. Anim. Breed. Genet.* **112**: 341-348.
- RÓŻYCKI M. 1996. Procedures applied for slaughter performance in testing station (In: Breeding State and Pig Evolution Results. National Institute of Husbandry, Kraków 1996, XIV): 69-82. (In Polish).
- RÓŻYCZKA J., KORTZ J., GRAJEWSKA-KOŁACZYK S. 1968. A simplified method of the objective measurement of colour in fresh pork meat. *Rocz. Nauk Rol.* **90-B-3**: 345-353.
- WANG L., YU T.-P., TUGGLE C. K., LIU H.-C., ROTHSCHILD M. F. 1998. A directed search for quantitative trait loci on chromosomes 4 and 7 in pigs. *J. Anim. Sci.* **76**: 2560-2567.