Electronic Journal of Polish Agricultural Universities is the very first Polish scientific journal published exclusively on the Internet, founded on January 1, 1998 by the following agricultural universities and higher schools of agriculture: University of Technology and Agriculture of Bydgoszcz, Agricultural University of Cracow, Agricultural University of Lublin, Agricultural University of Poznan, Higher School of Agriculture and Teacher Training Siedlce, Agricultural University of Szczecin, and Agricultural University of Wroclaw.

ELECTRONIC JOURNAL OF POLISH AGRICULTURAL UNIVERSITIES

2002
Volume 5
Issue 2
Series ANIMAL HUSBANDRY

KRZĘCIO E., ZYBERT A., KOĆWIN-PODSIADŁA M. 2002. EFFECT OF SLAUGHTER SEASON ON SOME PORK QUALITY PARAMETERS FOR FATTENERS OF VARIOUS HAL GENOTYPES **Electronic Journal of Polish Agricultural Universities**, Animal Husbandry, Volume 5, Issue 2.
Available Online http://www.ejpau.media.pl

EFFECT OF SLAUGHTER SEASON ON SOME PORK QUALITY PARAMETERS FOR FATTENERS OF VARIOUS HAL GENOTYPES

Elżbieta Krzęcio, Andrzej Zybert, Maria Koćwin-Podsiadła

Department of Pig Breeding and Meat Science, University of Podlasie, Poland

ABSTRACT

The studies were carried out on 158 Polish Landrace fatteners of various HAL genotypes, with average body weight 102 ±5.1 kg and 52.33% of leanness, slaughtered during two seasons: spring and summer as well as autumn and winter. Analysis of variance demonstrated statistically highly significant effect of HAL genotype on all the examined traits. The effect of slaughter season was found for pH_{24}, pH decrease range (pH_{45}–pH_{24}) and WHC. In respect to the pH_{24}, statistically significant interaction was found between both factors. Higher incidence of meat with PSE syndrome was observed in the spring–summer season (31.33%), which was reflected by more extensive drip loss from the LD muscle. In the group of HAL^{n} allele homozygotes, an increase in the dynamics of glycolytic metabolism was observed, especially in relation to the stress–resistant (HAL^{NN}) group of animals. As a consequence of the reactions, the value of pH_{45} was very low and the drop range of pH (from 45 min until 24 hrs after slaughter) was narrow, which in turn resulted in high incidence of PSE–affected carcasses among the stress–sensitive animals during both slaughter seasons.

Key words: slaughter season, HAL genotype, meat quality.

INTRODUCTION

The improvement of pig breeds and lines towards high leanness has resulted in an increased incidence of meat quality defects. The problem refers especially to the mass occurrence of PSE (pale, soft, exudative) meat syndrome. It has been known that the defect occurs either due to genetic factors (animals burdened with the stress–sensitivity gene HAL^n) or because of a range of environmental factors, such as slaughter season, pre–slaughter handling, and the slaughter itself.

The aim of this study was to analyse the effect of slaughter season on selected pork quality parameters in fatteners of varied HAL genotype.

MATERIALS AND METHODS

The study was carried out on 158 Polish Landrace fatteners managed in equal housing and feeding conditions, in a farm that was 55 km away from the slaughterhouse. Mean leanness of the analysed population oscillated around 52.33%. The animals were slaughtered at 102 kg ±5.1 kg of body weight in two seasons: 83 animals during spring and summer (30 indiv. NN, 30 indiv. Nn, and 23 indiv. nn) and 75 individuals in the autumn and winter seasons (30 indiv. NN, 30 indiv. Nn and 15 indiv. nn). The genotype of the animals, in the scope of the stress–sensitivity gene, was determined with PCR/RFLP [6]. Meat quality was evaluated in the tissue of *Longissimus dorsi* (LD) muscle, and expressed as pH after 45 minutes and 24 hours *post mortem* (pH_{45} and pH_{24}, respectively), meat lightness, water holding capacity (WHC), and muscle tissue energy metabolism ratio (R_1 = IMP/ATP). The pH measurements were carried out with a pH–meter type CP–311 (Elmetron). The meat lightness was determined with a Momcolor D–3098 instrument. WHC was determined with the method by Grau and Hamm [2], modified by Pohja and Ninivaara [9]. The R_1 index was estimated according to Honikel and Fischer [3]. The frequency of PSE pork occurrence was estimated basing on the values of pH_{45} and R_1, with the perimeter values $pH_{45} \leq 5.8$ and $R_1 \geq 1.05$.

The results were statistically processed using non–orthogonal, two–way ANOVA [11]. The means from the traits of the analysed groups were compared using Tukey's test [8].

RESULTS AND DISCUSSION

The ANOVA results demonstrated that HAL genotype had a highly significant effect on all the analysed traits. An effect of season was demonstrated in relation to pH_{24}, pH decrease range (pH_{45}–pH_{24}) and WHC. For the final acidity of muscle tissue (pH_{24}), statistically significant interaction was found between both factors (Table 1, Fig. 1).

Table 1. Effect of HAL genotype and slaughter season on the value of analysed meat–quality traits

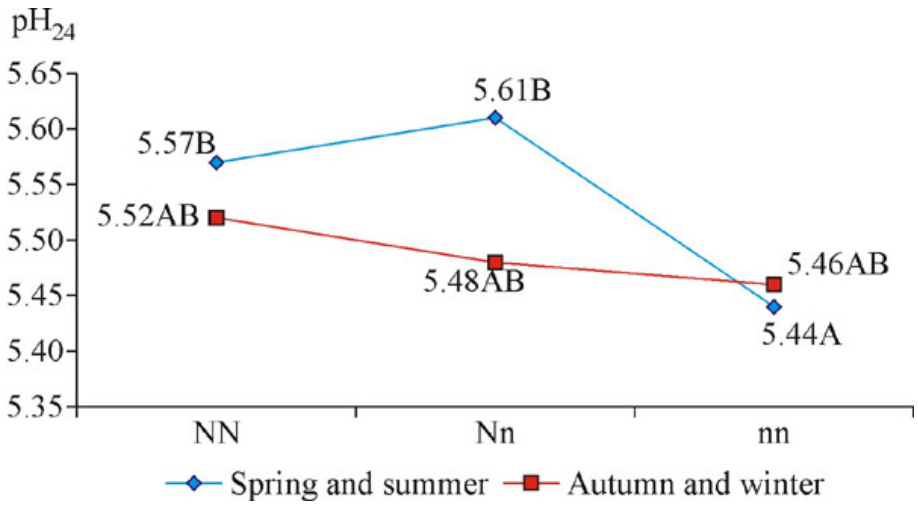
Trait	Effect of analysed factor			Effect of HAL genotype			Effect of slaughter season	
	HAL genotype	slaughter season	interaction (genotype season)	NN (n = 60)	Nn (n = 60)	nn (n = 38)	spring–summer (S–S)	autumn–winter (A–W)
pH_{45}	**	NS	NS	6.15 A ±0.27	6.01 B ±0.25	5.67 C ±0.23	5.95 ±0.30	6.02 ±0.32
R_1	**	NS	NS	0.98 A ±0.14	1.07 B ±0.14	1.17 C ±0.14	1.09 ±0.16	1.03 ±0.15
pH_{24}	**	*	*	5.55 A ±0.15	5.54 A ±0.15	5.45 B ±0.16	5.55 b ±0.14	5.49 a ±0.16
pH_{45}–pH_{24}	**	*	NS	0.61 A ±0.28	0.47 B ±0.24	0.24 C ±0.20	0.41 a ±0.25	0.54 b ±0.30
Meat lightness	**	NS	NS	16.67 A ±3.18	16.80 A ±3.51	19.69 B ±3.64	17.04 ±3.97	17.90 ±3.19
WHC (cm^2)	**	**	NS	5.07 A ±1.09	5.18A ±1.37	6.15B ±1.19	5.98B ±1.43	5.00 A ±0.88

Table 1 cont.

Effect of HAL genotype and slaughter season				
Trait	slaughter season	HAL genotype		
		NN	Nn	nn
pH_{45}	(S–S)	6.10 B±0.25	6.02 B±6.01	5.65 A±0.22
	(A–W)	6.19 B±0.28	6.01 B±0.28	5.71 A±0.28
R_1	(S–S)	1.01 A±0.15	1.09 A±0.14	1.19 B±0.15
	(A–W)	0.96 A±0.12	1.05 B±0.15	1.15 B±0.14
pH_{24}	(S–S)	5.57 B±0.15	5.61 B #±0.13	5.44 A±0.08
	(A–W)	5.52±0.13	5.48 #±0.14	5.46±0.24
pH_{45}–pH_{24}	(S–S)	0.53 B #±0.24	0.42 B±0.21	0.23 A±0.22
	(A–W)	0.69 B #±0.31	0.53 B±0.26	0.27 A±0.16
Meat lightness	(S–S)	16.09 A±3.14	15.78 A±3.79	19.90 B±3.81
	(A–W)	17.23±3.16	17.82±2.93	19.38±3.47
WHC (cm^2)	(S–S)	5.54 AB ##±1.23	5.44 A±1.64	6.50 B ##±1.82
	(A–W)	4.49 A ##±0.49	4.87 AB±0.95	5.48 B ##±0.82

Description: results are presented as mean values ± standard deviation; * – significant at p ≤ 0.05; NS – statistically non–significant; A, B – means marked with various capital letters in rows differ significantly at p ≤ 0.01; a, b – means marked with various lower–case letters in rows differ significantly at p ≤ 0.05; ## – means marked in columns differ significantly at p ≤ 0.01; # – means marked in columns differ significantly at p ≤ 0.05. ** – significant at p ≤ 0.01.

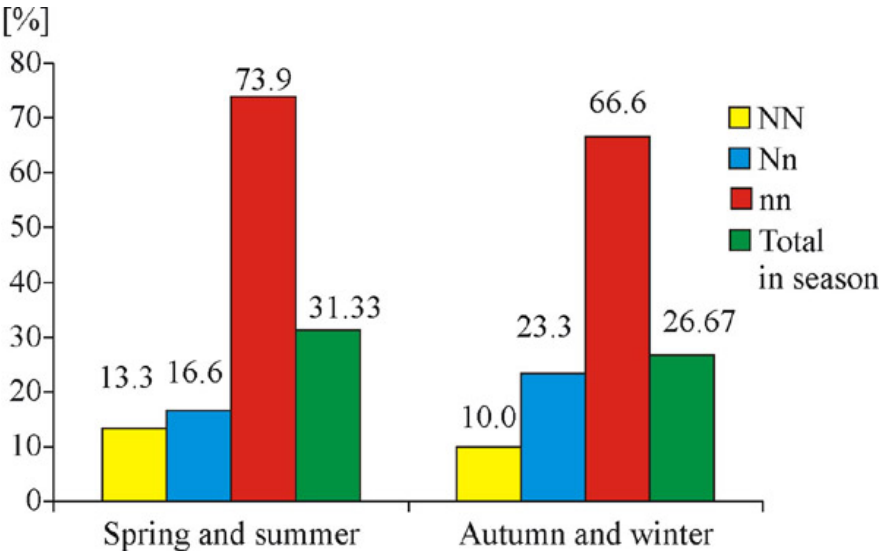
Fig. 1. Effect of slaughter season and HAL genotype on the value of pH_{24}



The results referring to the effect of the HAL gene on the studied meat quality traits confirmed the commonly known opinion about the adverse influence of HAL^n allele on pork quality [11]. The main objective of the study was an analysis of HAL^n gene effect on the meat quality in respect to the slaughter season. In the presented research, statistically significant effects of the season were found in relation to water holding capacity (WHC), final acidity of LD muscle tissue (pH_{24}) and pH decrease range. However, in relation to the final acidity of LD muscle tissue, expressed as pH in 24 hours *post* mortem, statistically significant ($p < 0.05$) interaction was found between both factors, i.e. HAL genotype and slaughter season (Fig. 1). The interaction, depicted in Fig. 1, indicate that in the pre–slaughter conditions of the spring–summer season the effect of HAL^N allele is dominant in relation to the allele HAL^n. During autumn and winter, however, the influence of either gene is not different, although this conclusion should be confirmed on a more numerous sample.

The fatteners slaughtered during spring and summer had higher drip loss from LD muscle despite their genotype, however for the stress–resistant (NN) and stress–sensitive (nn) animals, the differences between the seasons were confirmed statistically. This has been reflected in a higher incidence of carcasses with the PSE meat for the above–mentioned groups of animals slaughtered during spring and summer (Fig. 2).

Fig. 2. Frequency of PSE meat occurrence in relation to slaughter season and HAL genotype



What should be stressed here is the muscle tissue pH_{24} found in heterozygous fatteners, slaughtered during autumn and winter, as opposed to those values of this genetic group of animals which were slaughtered during spring and summer. At the same time it should be stressed that the Nn fatteners, slaughtered during both analysed seasons, were characterised by a very similar value of pH_{45} (6.02 and 6.01 respectively). Lower acidity of the LD muscle after 24 hrs after slaughter in the group of heterozygous fatteners, slaughtered during spring and summer, results probably from a higher use of glycogen in the metabolism which occur both during the pre–slaughter handling and directly (up to 45 minutes) after slaughter, which was confirmed by the results by Koćwin–Podsiadła *et al.* [5]. The reason of this effect could be sought in a stronger response of the animals to the transport conditions during spring and summer.

This effect probably has its background in an enhanced activity of thyroidal hormones in the animals burdened with the HAL^n gene [7]. Corresponding trends were found for the pigs resistant to stress, however these were not statistically proved. In the case of stress–sensitive pigs, on the other hand, the dynamics of glycogen decomposition to lactic acid were the most intensive in the period until 45 minutes after slaughter. During the subsequent time after slaughter, until 24 hours, glycogen metabolism in these animals, expressed in the range of pH decrease ($pH_{45} - pH_{24}$), did not depend on the season and was twice lower in comparison with the heterozygous animals, and 2.5–fold lower in relation to the stress–resistant animals. The narrow range of acidity changes in the muscle tissue of stress–sensitive pigs, from 45 minutes until 24 hours after slaughter, typical for the changes that occur in a PSE meat ($pH_{45} - pH_{24} = 0.23$ during spring and summer and 0.27 in autumn and winter) [10], results from intensive glycolytic metabolism, which occur directly after slaughter. As a consequence of these changes, a very low value of pH_{45} occurs and, in turn, a high frequency of PSE syndrome afflicted carcasses in both analysed seasons (73.9% during spring and summer and 66.6% during autumn and winter).

As it is presented in Fig. 2, a higher frequency of PSE meat occurrence in the entire analysed population was found during spring and summer (31.33% versus 26.67%). Also Bąk and Wajda [1] and Kaczorek *et al.* [4] reported the tendency of higher PSE incidence in the meat of the fatteners slaughtered during summer.

CONCLUSIONS

Higher frequency of occurrence for PSE–symptoms meat was noted during spring and summer (31.33%), which was reflected by a higher drip loss from LD muscle tissue during this season. An increase in glycolytic metabolism dynamics was observed in the group of homozygous animals HAL^nHAL^n, especially as compared with the stress–resistant group of animals. As a consequence of these changes, a very low value of pH_{45} and a low pH decrease (between 45 minutes and 24 hours after slaughter) and, in turn, a high frequency of PSE–afflicted carcasses of the stress–sensitive animals during both analysed seasons. In relation the final acidity of muscle tissue (pH_{24}), statistically significant interaction was found between both factors, i.e. HAL genotype and slaughter season, which indicated that allele HAL^N had a dominant influence on this trait in relation to allele HAL^n in the pre–slaughter conditions in spring and summer. However, both alleles had no individual effect in the conditions of autumn and winter.

REFERENCES

1. Bąk T., Wajda S., 1995. Wartość rzeźna tuczników w zależności od sposobu pojenia przed ubojem i pory roku [Slaughter value of pork in relation to season and watering before slaughter]. Rocz. Inst. Przem. Mięs. Tłuszcz., 32/34, 29–39 [in Polish].
2. Grau R., Hamm R., 1952. A clean and easy method of determination of water binding in meat [Reine einfasche Methode zur Bestimmung Wasserbindung in Fleisch]. Fleischwirtschaft 4, 295–297 [in German].
3. Honikel K.O., Fischer H., 1977. A rapid method for the detection of PSE and DFD porcine muscles. J. Food Sci., 42, 1633–1636.
4. Kaczorek S., Zybert A., Krzęcio S., Przybylski W., Koćwin–Podsiadła M., 1998. The influence of season of the year on frequency of faulty meat of fatteners. Pol. J. Food Nutr. Sci., 7/48 (4), 251–256.
5. Koćwin–Podsiadła M., Przybylski W., Fernandez X., Monin G., 1998. The comparison between NN and Nn pigs for meat quality and glycolytic potential measured before and after slaughter. 44thICoMST, Barcelona, Spain A.9, 278–279 and Ann. Anim. Sci., 1 (2), 31–36.
6. Kurył J. and Korwin–Kossakowska A., 1993. Genotyping of HAL locus by PCR method explains some cases of incomplete penetrance of HAL^{n} gene. Anim. Sci. Pap. Rep., 11, 271–277.
7. Mitchell G., Heffron J.J.A., 1982. Advances in Food Researche s 28, 167–229.
8. Oktaba W., 1980. Methods of Statistics in Experimental Design [Metody statystyki matematycznej w doświadczalnictwie]. PWRiL, Warszawa [in Polish].
9. Pohja N. S., Ninivaara F. G., 1957. Estimation of the water binding of meat by means of constant pressure [Die Estimmung der Wasserbindung des Fleisches mittels der Konstandruckmethods. Fleischwirtschaft 9, 193–195.
10. Przybylski W., Koćwin–Podsiadła M., Rozenek–Przybylska A., 1993. Wykrywalność mięsa wadliwego w zależności od kryteriów jego selekcji [A detection of a faulty meat depending on the criteria of its selection]. Zesz. Nauk. WSR–P. Ser. Zootech., 32, 175–185 [in Polish].
11. Ruszczyc Z., 1981. Metodyka doświadczeń zootechnicznych [Experimental Methods in Animal Husbandry]. PWRiL, Warszawa [in Polish].
12. Sellier P., 1998. Major genes and crossbreeding with reference to pork quality. Pol. J. Food Nutr. Sci., 7/48 (4), 77–89.

Elżbieta Krzęcio, Andrzej Zybert, Maria Koćwin–Podsiadła
Department of Pig Breeding and Meat Science
University of Podlasie
B. Prusa 14, 08–110 Siedlce, Poland
Phone/fax (025) 643 12 58
e–mail: elak@wsrp.siedlce.pl