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RESULTS OF MALIGNANT HYPERTHERMIA STATUS MONITORING IN CROATIAN PIG BREEDING

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Summary

Malignant hyperthermia of swine (MHS) is producing a major economic problem in pig breeding due to increased loss of piglets during the breeding and frequent occurrence of losses (mortality) in transport, especially at elevated temperatures. PSS causes pigs having lower meat quality and the processing of affected pig's meat brings larger losses in processes, which is all reflected in the quality of preserved food products. In Croatia, the systematic monitoring of PSS status and molecular genetic methods, in populations of commercial pig breeds is carried out since 2003 as part of implementing the national program of pig breeding. Testing the selected breeding pigs is carried out in the laboratory of Department of Central animal gene bank placed in Croatian Agricultural Agency, which is responsible for systematic monitoring of PSS on the national level. Status of PSS in systematically monitored by the methods of molecular genetics, Polymerase chain reaction (PCR). The aim of this paper is to show the results of monitoring the status of PSS in Croatian pig production from year 2003 to 2014, in which a total of 4363 boars of commercial pig breeds were tested. Results of laboratory tests of breeding boars and monitoring the PSS status in Croatian pigs for a period of more than a decade, indicate the success of protocol sets for monitoring and eliminting the breeding males of commercial pig breeds that are PSS positive. This conclusion is confirmed by the continuous rise in desirable genotype (Hal^{NN} and Hal^{Nn}) proportion of tested boars and reduction of Hal^{nn} as undesirable genotype. As one of the findings of this research is the fact that tracking of PSS status in Croatia applies only on the commercial breeds, but not on two native breeds of pigs (Black Slavonian and Turopolje pig) of which a high - quality traditional meat products are made, and that is the reason why it should be important to monitor PSS status in these two populations on regular basis.

Key words: malignant hyperthermia of swine (MHS), Hal gene frequency, Croatia

Introduction

In pig production, the control of stress factors is an important measure which affects the performance, animal welfare and consequently the quality of meat (J e r k o v i ć e t a l., 2009). The quality of pork is the sum of mutually interactive traits that are influenced by many factors such as the properties of muscle, manufacturing, environmental and genetic factors. Low heritability and difficult advancement of quantitative traits which define the quality of meat by selection determines that the measurement of these traits is complex, expensive and practicable only *post mortem*. But the tools of molecular genetics offer the ability to overcome these limitations by analyzing genetic variation on the level of DNA molecule. The stress response in pigs is closely associated with stress sensitivity gene (*Hal* gene), and disorder is called *malignant hyperthermia of swine* (MHS) or *porcine stress syndrome* (PSS). Symptoms of MHS are rapid breathing and heart rate, muscle tremors, elevated body temperature, partial to complete muscle stiffness and metabolic disorders, and in more severe cases even death (S a l a j p a l, 2007). Numerous studies confirm the less technological values of such meat and larger losses during processing and preserving the meat and meat products. PSS status in the Republic of Croatia has been systematically monitored in farming and breeding of commercial pigs at the national level since 2003 using molecular genetics methods, polymerase chain reaction.

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The analysis of biological samples of pigs (hair and / or tissue) is carried out in the laboratory of *Department of Central Bank of animal genes* placed in *Croatian Agricultural Agency*, which is within the responsibilities of keeping the Gene Bank of farm animals in the Republic of Croatian. The Department is responsible for systematic monitoring of PSS at the national level (Čačić et al., 2015), and the results of departments work were presented in the publication of first *Annual report* in 2014 and presented to experts and the general public (Croatian agricultural agency, 2015a). Laboratory testing for PSS were carried out for all of the young boars selected for breeding (Croatian livestock selection centre, 2000). Regardless of the production, phenotypic and genealogical data, young boars in which the tendency for PSS is noted are excluded from the breeding program, unless it is a Pietrain breed used in the terminal crossing.

Malignant hyperthermia and the impact on production traits of pigs

Malignant hyperthermia is hereditary neuromuscular diseases of pigs with a disorder of skeletal muscle contraction, metabolic acidosis, hyperthermia (MacLenan i Phillips, 1992; Gillard et al., 1991), tachycardia, tachypnea, increased consumption of oxygen, cyanosis, cardiac arrhythmia, respiratory acidosis, unstable arterial blood pressure and death (Susan, 1998). Already in the 1960s it became clear that in many cases physical stress causes collapse and death in sensitive pigs (Topel et al., 1968), and the appearance of pale, soft and exudative (PSE) meat, (Judge, 1972). Cristian (1972) is the one who first assumed that stress sensitivity is genetically inherited, as it was confirmed later on in many studies (Mabry et al., 1977, 1981; Minkema et al., 1976; O'Brien, 1986; Louis et al., 1992; i drugi). Numerous molecular studies have also confirmed the genetic inheritance (Fujii, 1991). A groundbreaking step of studing the stress sensitivity of pigs and PSE meat is the knowledge that the syndrome of malignant hyperthermia can be caused by short-term exposure to the halothane gas (Christian, 1974). When exposed to the gas, the mechanism of stress reactions started in pigs and in susceptible individuals signs of stress syndrome developed and expressed as malignant hyperthermia and rigidity of muscles. Animals susceptible to malignant hyperthermia slowly recovered after the influence of gas, and with prolonged activity of halothane gas frequent occurrences of death were observed (Webb i Jordan, 1978). Research based on reaction after exposed to halothane gas proven that stress sensitivity syndrome is inherited recessive (Ollivier et al., 1975). The gene responsible for sensitivity is called *Hal* (halothane) gene (Andresen i Jensen, 1977). It was found that the gene has two alleles: N (normal, dominant) and (halothane sensitive, recessive), but the main disadvantage of halothane test was detecting only those individuals susceptible to the disease (recessive homozygotes), but not the "carriers" of disorder (heterozygotes) (Minkema et al.,1977). Given the existence of two alleles, the appearance of three genotypes which define the status of MHS is possible: Hal^{NN} - dominant homozygote, Hal^{Nn} - heterozygote and Hal^{nn} - recessive homozygote. Gene for stress sensitivity is located at the 6th chromosome, (6p1.1-q2.1)

and encodes Ryanodine receptor 1 (RYR1) and Ca^{2+} permeable channels in sarcoplasmic reticulum membranes of muscle cells (S a l a j p a l, 2007). In several studies, in pigs susceptible to malignant hyperthermia a point mutation was determined in Ryanodine receptor gene, located on sixth chromosome, 6p1.1-q2.1 at the position 1843 in the sequence of nucleotides, where the Cytosine (C) nucleotide is replaced by Thymine (T), which results in replacement of Cysteine (Cys) with Arginine (Arg) at the aminoacid sequence (F u j i i e t a l., 1991; R i c h t e r e t a l., 1992; F l e t c h e r e t a l., 1993). Mutation C1843T in the RYR1 gene results in changes in the membrane permeability and increased Ca^{2+} ions releasing from the sarcoplasmic reticulum, in response to the action of strong stress, which induces increased metabolic activity within the muscle cells, and consequently the occurrence of PSS (F u j i i e t a l., 1991; R i c h t e r e t a l., 1992; F l e t c h e r e t a l., 1993). Methods of molecular genetics have made the link between mutation heredity and expression of disorder symptoms, and a new test based on the *Polymerase chain reaction* (PCR) to detect all three genotypes for PSS was described by F u j i e t a l. (1991), G i l l a r d e t a l. (1991) i T a d i ć (1994). The test is based on the selective amplification of mutated portions of RYR1 gene by PCR and sequencing the segments of restriction fragments. The test has proven to be very accurate and fast, enabling easy testing of large number of individuals in a short time and detecting all three PSS genotypes (L a c k o v i ć e t a l. 1997). Generally, the opinion based on the informations given by DNA molecules can assist pig production after eliminating certain undesirable genes from pig population, and also the impact of such genes on the meat quality (J e r k o v i ć e t a l., 2009). In addition, this information can help in quantitative traits selection, including those traits that can affect traditional orms of selection.

PSS has a major impact on production traits of pigs and pork products. Poorer quality meat in pigs of undesirable genotype (Hal^{nn}) defines L e a c h e t a l. (1996), F i s h e r e t a l. (2000), O t t o e t a l. (2007), S a l a j p a l (2007) etc. In pigs of Hal^{Nn} and Hal^{nn} genotypes, A a l h u s e t a l. (1991), P o m m i e r e t a l. (1992) i R o s n e r e t a l. (2003) determined a better expressive meatiness, increased content of muscle tissue in carcasses, but in the slaughtering line lower meat quality was found in comparison to the pigs of Hal^{NN} genotype, and they stated that the results of research were clearly associated with stress sensitivity and consequently the meat quality was worse. L a c k o v i ć e t a l. (1998) determined a better fattening abilities and expressive meatiness of the individuals of Hal^{Nn} genotype. M a r g e t a e t a l. (2010) determined that PSS affects the back fat, meatiness and loss of meat juice, and that individuals of Hal^{Nn} genotype have desirable production and processing characteristics. A little later, M a r g e t a e t a l. (2012) confirmed poorer fertility of sows inseminated with Hal^{Nn} genotyped boars. A l v e s e t a l. (2014) found lower body fat on the legs of individuals of Hal^{Nn} genotype.

The aim of research

The aim of this research is to show results of previous systematic monitoring of malignant hyperthermia status in commercial pig breeding at national level in the Republic of Croatia in the period from year 2003 to 2014.

Materials and methods

The study used laboratory PCR analysis of selected breeding boars tested for PSS. The analyzes were conducted in the laboratory of Department for Central Bank of animal genes. Results of laboratory analysis covering the period from the year 2003 to 2014 and overall analysis of 4363 boars, noting that the study does not include year 2013 because of the unavailability of data due to technical reasons (Table 1). The calculation of genotypes and alleles frequencies from laboratory analysis results for PSS boar testing was made by the Hardy - Weinberg method, which allows calculation of genotype frequencies, and predicting the changes in genes and genotypes frequencies in the populations (Hardy, 1908). The frequencies of genotypes (Hal^{NN} - dominant homozygote, Hal^{Nn} - heterozygote and Hal^{nn} - recessive homozygote) were determined according to the formula of HW law:

f (genotype) = N' (genotype) / N' (total),

where f is the frequency and N' is the number.

The frequencies of alleles (N and n) were determined from the genotype frequencies:

f (N) = f (NN) + f (½Nn) and f (n) = f (nn) + f (½Nn).

Results and discussion

In the period from the year 2003 to 2014, a 4363 young boars selected for breeding were tested for PSS, out of which 4147 (95%) are purebred and 216 (5%) are crossbred hybrids (Table 1). According to the share, the highest number of tested boars are from Landrace breed, followed Pietrain, Yorkshire and Duroc, as a result of commercial pig breeding program development in which the Landrace and Yorkshire are used for crossing and creating the high-quality breeding sows (F1 generation) and also Pietrain and Duroc boars are used as studs for terminal crossing and producing quality pigs for fattening (F2 generation).

Table 1. – TOTAL NUMBER OF TESTED BOARS ON PSS BY BREED THROUGH THE YEARS
Tablica 1. – UKUPAN BROJ TESTIRANIH RASPLODNIH NERASTOVA NA MHS PREMA PASMINAMA KROZ GODINE

		Years												Total	
Breed / *Crossbred*		2003.	2004.	2005.	2006.	2007.	2008.	2009.	2010.	2011.	2012.	2013.	2014.	No.	%
Pietrain		59	382	64	27	252	94	76	68	87	45	-	32	1186	27,1
Yorkshire		22	92	84	64	120	54	48	30	14	4	-	15	547	12,5
Landrace		95	161	199	89	572	344	300	192	154	69	-	132	2307	52,9
Duroc		-	52	14	1	3	5	8	5	3	3	-	13	107	2,5
Landrace × Yorkshire		-	*40*	-	*12*	*30*	-	-	-	-	-	-	-	*82*	*1,9*
Durok × Yorkshire		-	*6*	*4*	*1*	*3*	-	-	-	-	-	-	-	*14*	*0,3*
Pietrain × Duroc		-	*12*	*2*	-	*5*	-	-	-	-	-	-	-	*19*	*0,4*
Duroc × Landrace		-	*16*	-	-	-	-	-	-	-	-	-	*8*	*24*	*0,6*
Yorkshire × Pietrain		-	-	-	-	*8*	-	-	-	-	-	-	-	*8*	*0,2*
Landrace × Pietrain		-	-	-	-	-	*2*	*10*	*2*	*9*	-	-	-	*23*	*0,5*
Crossbred - others		-	-	-	*46*	-	-	-	-	-	-	-	-	*46*	*1,1*
Total by the years	No.	176	761	367	240	993	499	442	297	267	121	0	200	4363	100
	%	4,2	17,5	8,5	5,5	22,8	11,5	10,5	6,8	5,3	2,8	0	4,6	100	

According to the years, the number of pigs under selection has the trend of continuous falling (C r o a t i a n a g r i c u l t u r a l a g a n c y, 2015b), and accordingly from the point of monitoring the status of PSS, we can see the negative trend in the number of analyzed breeding boars (Table 1). In order to monitor the PSS in Croatia, the laboratory analysis of boar status have shown the expected frequencies of all three PSS genotypes (Hal^{NN}, Hal^{Nn} and Hal^{nn}) (Table 2). The total frequency of genotypes Hal^{NN} : Hal^{Nn} : Hal^{nn} is 72.7: 24.1: 3.2, while the frequency of alleles N : n is 84.7 : 15.26. Looking at the genotype representation through the years, there is an increasing share of the desirable Hal^{NN} and Hal^{Nn} genotypes and reducing the frequency of undesirable genotype Hal^{nn} (Table 2).

Table 2. – TOTAL NUMBER OF TESTED BOARS ON PSS AND GENOTYPE FREQUENCIES THROUGH THE YEARS
Tablica 2. – UKUPAN BROJ TESTIRANIH RASPLODNIH NERASTOVA NA MHS I FREKVENCIJE GENOTIPOVA KROZ GODINE

	Genotype		
Year	NN No. of head (%)	Nn No. of head (%)	nn No. of head (%)
2003.	106 (60,2)	52 (29,5)	18 (10,2)
2004.	529 (69,5)	189 (24,8)	43 (5,6)
2005.	251 (68,4)	96 (26,1)	20 (5,4)
2006.	158 (66,5)	76 (30,2)	6 (2,5)
2007.	621 (62,5)	336 (33,8)	36 (3,6)
2008.	364 (72,9)	132 (26,4)	3 (0,6)
2009.	378 (85,5)	63 (14,2)	1 (0,2)
2010.	256 (86,2)	40 (13,4)	1 (0,3)
2011.	227 (85,0)	35 (13,1)	5 (1,8)
2012.	105 (86,7)	11 (9,1)	5 (4,1)
2013.	0 (0)	0 (0)	0 (0)
2014.	174 (87,0)	24 (12,0)	2 (1,0)
Total gene frequencies	3170 (72,7)	1054 (24,1)	140 (3,2)
Frequencies of alleles (N : n)	84,74 : 15,26		

In terms of breeds, in the Duroc boars only Hal^{NN} genotype has been found (Table 3). In the Yorkshire boars appearance of undesirable genotype Hal^{nn} has not been determined, while the same genotype is in a very small proportion (0.4%) present in the Landrace boars. As expected, the Pietrain had the most stressful and sensitive boars (10.9%). The ratio of alleles N : n is 84.9: 15.1 in purebred boars. In crossbred hybrid boars compared to purebred, it has been determined lower proportion of genotypes Hal^{NN} (8.3%) and Hal^{nn} (2.4%), and a higher proportion of genotype Hal^{Nn} (10.6%) (Table 4). The calculation of allele frequencies indicates a higher proportion of allele *n* by 2.9% compared to purebred boars.

If we compare the results of this study and previous studies conducted by L a c k o v i ć e t a l., (1997) and L a c k o v i ć e t a l. (1998), it shows that earlier studies used pigs of both sexes in the research, but also a much smaller number of individuals (285 and 637) with respect to this research which included results of laboratory analysis for 4363 pigs tested for PSS but all the individuals were breeding boars. Comparison of earlier researches of PSS status in the population of commercial breeds and their crosses in Croatia and this research shows Table 5. In comparison to previous researches, in this paper a higher frequency of recessive allele *n* was found as the carrier of the mutation that causes stress sensitivity in pigs, which can partly be explained by a much larger number of analyzed pigs in the study. This opinion is based on a comparison of results analysis of boars tested in the study conducted by L a c k o v i ć e t a l. (1997) and results of this research, and it is clear that the previous authors confirmed higher proportion of genotype Hal^{NN} and lower presence of genotypes Hal^{Nn} and Hal^{nn}. On the other hand, the research also conducted by L a c k o v i ć e t a l. (1998) on a bigger number of pigs resulted in lower proportion of genotypes Hal^{NN} and Hal^{nn}, and a significantly higher proportion of genotype Hal^{Nn} compared to the previous study by the same authors, and in parallel comparison with this research also had a lower proportion of genotypes Hal^{NN} and Hal^{nn} and a higher proportion of Hal^{Nn} genotype.

Table 3. – TOTAL NUMBER OF TESTED PUREBRED BOARS ON PSS BY BREED, ALLELE FREQUENCIES AND GENOTYPE FREQUENCIES THROUGH THE YEARS
Tablica 3. – UKUPAN BROJ ČISTOKRVNIH TESTIRANIH RASPLODNIH NERASTOVA NA MHS PREMA PASMINAMA, FREKVENCIJE ALELA I FREKVENCIJE GENOTIPOVA KROZ GODINE

		Years													Frequency (%)		
Breed	Genotype	2003.	2004.	2005.	2006.	2007.	2008.	2009.	2010.	2011.	2012.	2013.	2014.	Total:	Genotype	Allele N	Allele n
Pietrain	NN	14	202	7	7	41	30	42	36	51	30	-	13	473	39,9	64,5	35,5
	Nn	30	138	40	15	178	61	33	31	31	10	-	17	584	49,2		
	nn	15	42	17	5	33	3	1	1	5	5	-	2	129	10,9		
Yorkshire	NN	21	77	79	62	107	53	45	30	14	4	-	15	507	92,7	96,3	3,7
	Nn	1	15	5	2	13	1	3	-	-	-	-	-	40	7,3		
	nn	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Landrace	NN	71	140	147	72	427	274	278	184	152	68	-	129	1942	84,2	91,8	8,2
	Nn	21	21	49	17	142	70	22	8	2	1	-	3	356	15,4		
	nn	3	-	3	-	3	-	-	-	-	-	-	-	9	0,4		
Duroc	NN	-	52	14	1	3	5	8	5	3	3	-	13	107	100	100	-
	Nn	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	nn	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total by the genotypes:	NN	106	471	247	149	578	362	373	255	220	105	-	170	3036	73,1	84,9	15,1
	Nn	52	174	94	34	333	132	58	39	33	11	-	20	980	23,6		
	nn	18	42	20	5	36	3	1	1	5	5	-	2	138	3,3		
Total by the years:		176	687	361	188	947	497	432	295	258	121	-	192	4154			

Table 4. – TOTAL NUMBER OF TESTED CROSSBRED BOARS ON PSS BY BREED, ALLELE FREQUENCIES AND GENOTYPE FREQUENCIES THROUGH THE YEARS
Tablica 4. – BROJ TESTIRANIH KRIŽANIH RASPLODNIH NERASTOVA NA MHS PREMA PASMINAMA, FREKVENCIJE ALELA I FREKVENCIJE GENOTIPOVA KROZ GODINE

		Years												Total:	Frequency (%)		
Crossbred	Genotype	2003.	2004.	2005.	2006.	2007.	2008.	2009.	2010.	2011.	2012.	2013.	2014.		Genotype	Alelle N	Alelle n
Landrace × Yorkshire	NN	-	30	-	5	30	-	-	-	-	-	-	-	65	79,3	89	11
	Nn	-	9	-	7	-	-	-	-	-	-	-	-	16	19,5		
	nn	-	1	-	-	-	-	-	-	-	-	-	-	1	1,2		
Duroc × Yorkshire	NN	-	5	4	1	3	-	-	-	-	-	-	-	13	92,9	96,4	3,6
	Nn	-	1	-	-	-	-	-	-	-	-	-	-	1	7,1		
	nn	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Pietrain × Duroc	NN	-	9	-	-	2	-	-	-	-	-	-	-	11	57,9	78,9	21,1
	Nn	-	3	2	-	3	-	-	-	-	-	-	-	8	42,1		
	nn	-		-		-	-	-	-	-	-	-	-	-	-		
Duroc × Landrace	NN	-	14	-	-	-	-	-	-	-	-	-	4	18	75	87,5	12,5
	Nn	-	2	-	-	-	-	-	-	-	-	-	4	6	25		
	nn	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Yorkshire × Pietrain	NN	-	-	-	-	8	-	-	-	-	-	-	-	8	100	100	-
	Nn	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	nn	-	-	-	-		-	-	-	-	-	-	-	-	-		
Landrace × Pietrain	NN	-	-	-	-	-	2	5	1	7	-	-	-	15	65,2	82,6	17,4
	Nn	-	-	-	-	-	-	5	1	2	-	-	-	8	34,8		
	nn	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Crossbred - other	NN	-			10	-	-	-	-	-	-	-	-	10	21,7	59,7	40,3
	Nn	-	-	-	35	-	-	-	-	-	-	-	-	35	76,1		
	nn	-			1		-	-	-	-	-	-	-	1	2,2		
Total by the genotypes:	NN	-	58	4	16	43	2	5	1	7	-	-	4	140	64,8	81,9	18
	Nn	-	15	2	42	3	-	5	1	2	-	-	4	74	34,2		
	nn	-	1	-	1	-		-	-	-	-	-	-	2	0,9		
Total by the years:		-	74	6	59	46	2	10	2	9	-	-	8	216			

Table 5. – COMPARISON OF THIS RESEARCH (*Čačić et al.*, 2015) WITH EARLIER RESEARCHES
Tablica 5. – USPOREDBA REZULTATA OVOGA ISTRAŽIVANJA (*Čačić i sur.*, 2015) S RANIJIM RADOVIMA

Research	Number of analysed pigs		Number of homozygotes *NN*	Number of heterozygotes *Nn*	Number of homozygotes *nn*	Frequency of *n* allele
Lacković et al. (1997)*	total	285	250 (87,72)	32 (11,23)	3 (1,05)	0,067
	boars	133	113 (85)	18 (13,5)	2 (1,5)	
Lacković et al. (1998)*	total	637	587 (92,15)	40 (6,28)	10 (1,57)	0,047
	boars	151	102 (67,44)	47 (31,24)	2 (1,32)	
Čačić et al. (2015)**	boars	4363	3170 (72,7)	1054 (24,1)	140 (3,2)	0,153

* previous researches; ** this research

Conclusion

On the national level in Croatia, the systematical tracking of PSS status using molecular genetic methods in populations of commercial pig breeds is carried out since 2003 as part of the implementation of the national program for breeding pigs. Results of laboratory tests of breeding

boars and monitoring PSS status in Croatian pig for a period of more than a decade, indicates the success using the set of protocols for monitoring and elimination of breeding stress - sensitive breeding males of commercial pig breeds. Although, unfortunately the trend of commercial pig breeds under selection is in continuous decline in Croatia, and consequently the number of breeding boars analyzed, we can see a continuous increase in the proportion of tested boars with desirable genotypes like Hal^{NN} and Hal^{Nn}, and reducing the share of genotype Hal^{nn}. Compared to previous studies, which are based on PSS status in Croatian populations of pigs, this study which is based on a large number of tested males can be considered research that has faithfully displayed the status of PSS in Croatian pigs. Therefore, this study should be taken as a measure of quality and the basis for further follow-up research of PSS status in pig breeding, as from genetic, also from organizational point of view in monitoring PSS in Croatia that is conducted by the Croatian agricultural agency. However, in the systematic monitoring of PSS status, Black Slavonian pig and the Turopolje pig are not included, as the only two native pig breeds of Croatia (Official Gazette 127/98). Today, when industrialized agricultural production dominates, there are several reasons for the preservation and enhancement of our native breeds, some of which produce popular traditional meat products, why it is very important to establish and monitor the PSS status in populations of these two native breeds of pigs.

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REZULTATI SUSTAVNOG PRAĆENJA STATUSA MALIGNE HIPERTERMIJE U HRVATSKOM SVINJOGOJSTVU

Sažetak

Maligna hipertermija svinja (MHS) predstavlja u svinjojgojskoj proizvodnji veliki ekonomski problem zbog većih gubitka prasadi u uzgoju i frekventnije pojave gubitaka (uginućem) u transportu, posebice pri povišenim temperaturama. Stresno osjetljive svinje imaju slabiju kakvoću mesa, a pri preradi mesa svinja podložnih MHS-u pojavljuju se veći gubici u procesima prerade, što se odražava na kvalitetu trajnih prehrambenih proizvoda. U Republici Hrvatskoj, sustavno praćenje statusa MHS-a molekularno genetskim metodama u populacijama komercijalnih pasmina svinja provodi se od 2003. godine kao sastavni dio provedbe nacionalnog programa uzgoja svinja. Testiranje odabranih rasplodnih svinja provodi se u laboratoriju Odjela za Središnju banku animalnih gena Hrvatske poljoprivredne agencije, koja je zadužena za sustav praćenja MHS-a na nacionalnoj razini. Status MHS-a sustavno se prati metodom molekularne genetike, polimeraznom lančanom reakcijom (PCR). Cilj ovoga rada bio je prikazati rezultate praćenja statusa MHS-a u hrvatskom svinjogojstvu u razdoblju od 2003. do 2014. godine, tokom kojeg je ukupno testirano 4363 nerasta komercijalnih pasmina svinja. Rezultati laboratorijskog testiranja rasplodnih nerastova i praćenja statusa MHS-a u hrvatskom svinjogojstvu u razdoblju dužem od jednog desetljeća, ukazuju na uspješnost postavljenog protokola praćenja i izlučivanja iz uzgoja stresno osjetljivih muških rasplodnih jedinki komercijalnih pasmina svinja. Ovaj zaključak potvrđuje kontinuirani porast udjela testiranih nerastova poželjnih Hal^{NN} i Hal^{Nn} genotipova, odnosno smanjenje udjela genotipa Hal^{nn}. Kao jedna od spoznaja ovog istraživanja je i činjenica da bi se obvezno praćenje statusa MHS u Republici Hrvatskoj osim na komercijalnim pasminama trebalo provoditi i na dvije izvorne pasmine svinja (crnoj slavonskoj i turopoljskoj) Republike Hrvatske, od kojih se proizvode kvalitetni tradicijski suhomesnati proizvodi, zbog čega bi upravo bilo značajno uvesti redovno praćenje MHS statusa i u ove dvije populacije.

Ključne riječi: maligna hipertermija svinja (MHS), Hal gene, Republika Hrvatska.

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