STRESS SENSITIVITY AND MEAT QUALITY EVALUATION BY BIOPSY METHOD

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SUMMARY

Meat quality was assessed using biopsy test in pigs from the Slovakian Landrace. Pigs with bad meat quality had smaller litters, a lower birth weight and better carcass parameters than pigs with good meat quality. By halothane and biopsy testing, 3 groups of pigs were constituted: H^-B^- (halothane-negative, good meat quality), H^-B^+ (halothane-negative, bad meat quality) and H^+B^+ (halothane-positive, bad meat quality). Groups H^+B^+ and H^-B^+ had higher fattening and carcass values, and worse meat quality, than H^-B^- pigs. Activities of LD, CK, Alanine and Asparagine transferase in blood as measured after an exercise stress were higher in H^+B^+ and H^-B^+ than in H^-B^- pigs.

INTRODUCTION

Porcine stress syndrome (PSS) is known to be controlled by the recessive halothane gene . The effect of halothane sensitivity on traits of economical importance has been studied extensively (review by Monin, 1989). Many studies have shown that the halothane gene can influence lean content and certain meat quality criteria (Sellier, 1988). It was also shown that meat quality of halothane negative pigs can vary widely whereas halothane-positive pigs may give inferior quality irrespective of management (Barton-Gade, 1984). Several biochemical and biophysical criteria were studied in relation with stress-susceptibility and halothane gene in pigs (Lahucky etal, 1980, Kovac et al., 1985, Lengerken et al., 1991, Cheah et al.,1991). Kovac et al. (1985) compared different methods for meat quality prediction. They found the following values for the frequency of PSE meat : 93.1% by biopsy test, 85.0% by halothane test, 66.0% by creatine kinase test after exercise stress, and 57.1% by myostress (injection of neostygmine and atropine, Bickhard and Richter,1980).

The aim of the present work was: 1/ to assess the efficiency of the biopsy test method to evaluate meat quality in a population of halothane-negative Slovakian Landrace pigs 2/ to study the relationships between meat quality and some reproduction and fattening traits.

MATERIAL AND METHODS

Thousand and two hundred fourty pigs were tested at a liveweight of 90-100 kg by shot biopsy of musculus longissimus dorsi (M l d.) using a recently developed spring loaded biopsy instrument (Schöberlein, 1976, Kovac et al., 1992). On the basis of this test (biopsy samples were incubated for 1 hour at 39°C before measurement of pH and R values), two groups of pigs with bad meat quality were chosen in order to create a line of pigs with bad meat quality : a group with $pH_1 < 5.8$ (refered to as B^+) and a group with $pH_1 < 5.6$ (refered to as B^{++}). Pigs from these groups were crossed ($B^+ \times B^{++}$) and 326 piglets were obtained. They were halothane tested (5% halothane, 5 min, halothane-negative H^-, halothane- positive H^+) then tested for meat quality by biopsy. In parallel, 650 pigs with good meat quality were halothane tested and also tested for meat quality by biopsy. From the total of these pigs (326 + 650) 3 experimental groups of the 10 animals each, were created : one group of halothane-negative with good meat quality (H^-B^-), one group of halothane-negative with bad meat quality (H^-B^+) and one group of halothane positive and bad meat quality (H^+B^+). These 3 groups were submitted again to biopsy test at a liveweight of 80-90kg . At 95 kg, a catheter was led into the vena cava by surgery. Animals were submitted to exercisse stress (walking for 250-700 m according to animal condition). Enzyme activities (Lactate dehydrogenase,UV test ; Creatine Kinase, Monotest-Boehringer ; Aspartate and Alanine transferase, Bio-La-Test, Lachema) and 17-OH corticosteroids (Porter, Silber spectrofluorescent method) were estimated in blood.

Meat quality was assessed after slaughter of animals by measurement of pH1, pH ultimate, R value (Honikel,Fischer,1977), WHC (drip loss) and meat colour (reflectance at 520 nm).

Statistical evaluation of the data was done by t- test; data are presented as mean ± s.d.

Fig. 3: fibre type portions (%) and diameters (µm) of the M. rectus abd. (n=27), M. obliquus abd. externus (n=21) and M. longissimus (n=30)

RESULTS AND DISCUSION

Table 1 shows results relative to reproduction ability of the pigs clasified according to meat quality.

Table 1 : Results from reproduction ability of pigs with different meat quality.

	born per litter	mean ± s.d. birth weight	age at slaughter (days)
Group of pigs with bad meat quality	8.35 1.32	50.68 6.30	181.2 33.2
Group of pigs with good meat quality	9.53 1.19	55.92 5.96	162.4 2.9

Pigs with bad meat quality produced smaller litters with a lower birth weight. Their age at slaughter was higher. Differences were significant ($P < 0.001$).

Among the 326 pigs with bad meat quality, 26.5% were halothane-positive, 72.6% showed bad meat quality as measured by biopsy test, and 69.8% showed bad meat quality after slaughter.

Results of fattening and carcass evaluation of pigs tested by both halothane and biopsy are given in table 2. The best average daily gain was found in the group H^-B^+. Similar tendences were found also for the length of the fattening period (30-100kg liveweight) which was the smallest for the group H^-B^+ ($P<0.05$;$P<0.01$).

Pigs with bad meat quality had higher carcass parameters (percentage of valuable meat parts and percentage of meat in ham) than pigs with good meat quality ($P<0.01$ and $P<0.001$). Differences on the datas of back fat thickness and slaughtered length between groups $H^+B^+$and H^-B^- were significant ($P<0.05$).

Values of meat quality evaluated either ante mortem by biopsy test or post mortem are given in Table 3. On the basis of pH_1 (biopsy) and R value as measured on biopsy sample, only pigs from a group H^-B^- showed good meat quality. Results showed that the group H^+B^- had the worst meat quality, while H^-B^- had the best, as assessed also by meat colour (respectively 32.7 ± 7.9 vs. 27.0 ± 4.1) The group H^-B^+ was intermediate but closer to the group H^+B^+ (31.7 ± 5.2).

Results confirmed that meat quality evaluation by biopsy test is a good predictor of meat quality after slaughter as previously shown (Lahucky et al.,1980, Kovac et al.,1985, Lengerken et al.,1991). Biopsy values allowed to discriminate between pigs with good and with bad meat quality among the H^- pigs. Recently Cheah et al. (1991) introduced a quick WHC biopsy test which could bring further information for prediction of PSE proneness in pigs.

Genetic antagonism between meat quantity and meat quality was suggested also from our results as was previously shown in many articles and reviewed by Sellier (1988). Results also confirmed possibly negative effects on technological qualities of pigs H^+B^+ regarding pH_1 and ultimate pH (Monin 1989). The work is continued to estimate genetic correlations between growth and carcass parameters and meat quality traits in groups of pigs tested by halothane and biopsy .

Results of enzyme activities (Table 4) in blood after standardized loading of pigs supported the differences in meat quality between experimental groups but we found out elevation on 17-OH corticosteroids only in the group H^-B^+.

CONCLUSION

The present results confirmed that pigs with bad meat quality have a lower reproduction rate, a more sensitive reaction on standardized loading, higher fattening and carcass values. Meat quality evaluation by biopsy test due to its simplicity and high reliability can be used in programmes of pig breeding.

TABLE 2 : FATTENING AND SLAUGHTER TRAITS IN HALOTHANE AND BIOPSY TESTED PIGS

DATA	GROUP	mean ± s.d.		t - test		
				1 vs. 2	1 vs. 3	2 vs. 3
AVERAGE DAILY GAIN FROM 30 TO 100 KG (g)	1	683	97	+	-	+++
	2	764	55			
	3	684	71			
NUMBER OF FEEDING DAYS FROM 30 TO 100 KG	1	104	13,50	+	-	+++
	2	92	6,93			
	3	102	9,50			
PERCENTAGE OF VALUABLE MEAT PARTS	1	50,81	2,44	-	++	+++
	2	51,20	1,45			
	3	47,74	2,78			
MEAT PERCENTAGE IN HAM	1	21,28	1,40	-	+++	+++
	2	21,43	0,95			
	3	19,31	1,50			
BACKFAT THICKNESS (cm)	1	2,33	0,23	-	+	-
	2	2,44	0,31			
	3	2,63	0,32			
BODY LENGTH (cm)	1	77,25	2,76	-	+	-
	2	79,00	2,39			
	3	79,04	2,39			

GROUP 1 : H+ B+ ; 2 : H- B+ ; 3 : H- B- P 0,05 +;P 0,01 ++;P 0,001 +++

TABLE 3 : MEAT QUALITY TRAITS IN LONGISSIMUS DORSI OF HALOTHANE AND BIOPSY TESTED PIGS.

DATA	GROUP	mean ± s.d.		t - test		
				1 vs. 2	1 vs. 3	2 vs. 3
pH 1 IN BIOPSY SAMPLE	1	5.31	0.11	+++	+++	+++
	2	5.56	0.13			
	3	6.22	0.22			
R - VALUE A 250/260 IN BIOPSY SAMPLE	1	1.32	0.21	-	+++	+++
	2	1.23	0.11			
	3	0.98	0.11			
pH 1 POST MORTEM	1	5.42	0.28	+	+++	+++
	2	5.81	0.33			
	3	6.25	0.28			
R - VALUE A 250/260 POST MORTEM	1	1.27	0.08	-	+++	+++
	2	1.18	0.17			
	3	0.95	0.08			
pH 2 POST MORTEM	1	5.32	0.19	+	+++	-
	2	5.50	0.07			
	3	5.55	0.16			
FREE WATER (drip loss)	1	9.28	3.84	-	+	-
	2	7.55	1.77			
	3	6.77	2.56			

GROUP : 1 H+ B+ ; 2 : H- B+ ; 3 : H- B- P 0,05 +; P 0,01 ++; P 0,001+++

TABLE 4 : BIOCHEMICAL CHARACTERISTICS OF BLOOD PLASMA AT 24 HOURS STRESS

DATA	GROUP	mean ± s.d.		t-test 1 vs.2	t-test 1vs.3	t-test 2 vs.3
Lactate Dehydrogenase (U/l)	1	621	338	++	+++	++
	2	305	123			
	3	205	77			
Creatine Kinase (U/l)	1	1738	878	+	+++	+++
	2	974	439			
	3	281	240			
Alanine transferase ALT (µkat/l)	1	0.55	0.26	-	++	-
	2	0.38	0.07			
	3	0.37	0.09			
Aspartate transferase AST (µkat/l)	1	0.42	0.18	+	+++	+
	2	0.26	0.08			
	3	0.19	0.09			
17-OH corticosteroids (mmol/l)	1	161	47	+	-	++
	2	242	81			
	3	192	70			

GROUP : 1 : H+ B+ ; 2 : H- B ; 3 : H- B-; P 0,05 +; P 0.01 ++; P 0.001 +++

REFERENCES

Barton-Gade,P.(1984). Proc. European Meeting of Meat Research Workers,30,8

Bickhardt,K. and Richter,L. (1980).Dt. Tierarzt.Wschr.,Hannover,87,269.

Honikel,O.K.,Fischer,C. (1977). Fleichwirtchaft,57,1015.

Cheah,K.S.,Cheah,A.M.,Lahucky,R.,Mojto,J.,Poltarsky,J.(1991).Proceed. 37th ICMST, Kulmbach,64.

Kovac,L.,Sidor,V.,Mlynek,J.,Vavrisinova,K.,Lahucky,R.(1985). 4th Int. Symp.,Nitra,Czechoslovakia,102.

Kovac,L.,Mlynek,J.,Lahucky,R.,Elias,J.(1992). Veterinarstvi (Prague),in press.

Lahucky,R.,Rajtar,V.,Kovac,L.,Sidor,V.(1980). Proc. Wiss. Symp., Leipzig, 79

Von Lengerken ,G.,Wicke,M.,Maak,S.,Paulke,T.(1991). Arch. Tierz.(Dummerstorf) 34,6,554.

Monin,G.(1989). 40th Annual Meeting of the European Assoc. Anim. Prod.,Dublin,Ireland,GP 3.1

Schöberlein,L.(1976). Mh. Vet. Med. (Jena),457.

Sellier,P.(1988). Journées Rech. Porcine en France,20,227.