



## EFFECT OF LAIRAGE TIME ON INCIDENCE OF DIFFERENT QUALITY OF *M. SEMIMEMBRANOSUS* FROM HALVES OF MULTI-RACE HYBRIDS

Tomović, V.<sup>1</sup>, Petrović Lj.<sup>1</sup>, Džinić, N.<sup>1</sup>, Manojlović, D.<sup>1</sup>, Timanović, S.<sup>2</sup>, Vidarić D.<sup>2</sup>

<sup>1</sup>Faculty of Technology, Bul. Cara Lazara 1, 21000 Novi Sad, University of Novi Sad, Serbia and Montenegro

<sup>2</sup>MI "Neoplanta", Primorska 90, 21000 Novi Sad, Serbia and Montenegro

### Background

Pigs are prepared for slaughter in the lairage, and the aim of resting is to bring back the animals to »normal« state, as they were at the breeding place, e.g. the resynthesis of glycogen in the muscles and removal of metabolite products. The resting time should be proportional to the fatigue due to transport, elsewhere, longer time may have a contrary effect. While in lairage, unnecessary stress and disturbances should be avoided (Rede and Ljiljana Petrović, 1997; Lawrie, 1998). According to a number of authors, resting after transport of pigs affects positively the quality of meat. Fortin (1988) found decrease of PSE incidence by 27% in pigs slaughtered 3 hours after the transport at the slaughterhouse, compared with pigs slaughtered next to the arrival. Grandin (1989) found 1,3% of PSE meat incidence in pigs slaughtered 2,5 h after the arrival to the slaughterhouse, and in pigs slaughtered 15 min after the arrival the PSE meat incidence was significantly higher, up to 18%. The slaughter immediately or a short time after the arrival can increase the incidence of PSE meat (Eikelenboom et al., 1991). Malligan et al., 1998; van der Wal et al., 1997; Wariss et al. (1998) cite that the most favorable resting time is 2-3 hours. Bendal and Swatland (1988) and Wittmann et al. (1989) found that very long resting can induce the appearance of DFD meat.

### Objective

The objective of this study was to investigate the quality of the halves of three-race pigs obtained in a mutual crossbreeding program at a farm in Serbia and Montenegro, and the influence of lairage time on meat quality. Further, to determine the incidence of different quality (RFN, RSE, PSE, DFD) on the basis of technological parameters pH<sub>i</sub>, pH<sub>u</sub>, WHC and L\*, measured on *M. semimembranosus* as well as of our quality criteria (Tomović, 2002; Natalija Džinić et al., 2003, 2004).

### Materials and methods

Two groups of pigs, multi-race hybrids, in all 33, were investigated. The pigs from the first group were slaughtered immediately after the transport (n=15) and the other group after resting of 48 hours in the lairage (n=18). The pigs were fed conventional feed during fattening, and heads of approximately same age and uniform mass were transported in autumn (october–november) to the slaughter-house, about 10 km from the farm. The pigs were stunned, debleded and processed on the slaughterline applying standard technological procedure.

The quality of halves was determined on right halves at the end of the slaughterline, using the FOM-device (SFK-Technology, Denmark).

The temperature was determined in *M. semimembranosus* (MSM) of right halves 45 min post mortem (T<sub>i</sub>) using the portable thermometer, HI 8757 (Hanna Instruments, Italy).

The pH<sub>i</sub> was measured in right halves 45 min p.m., and pH<sub>u</sub> 24 hours p.m. in the caudo-medial part (MSM) with pH-meter ULTRA X, UX-390 (Gronert, Germany) with INGOLD combined penetrating electrode.

Meat yield (%) was determined by partial dissection method (Walstra and Merkus, 1996) of cooled left halves.

Samples (200 – 300 g), taken at the caudo-cranial part (MSM) were used 24 hours p.m. for color and water holding capacity (WHC) determination. Colour was determined using the MOM Color 100 device (CIE L\*a\*b\*) (Robertson, 1977). WHC was determined using the compression method and expressed as % of bound water (Grau and Hamm, 1957).

The incidence of different MSM quality depending on resting time in the lairage was determined on the basis of parameters and quality criteria for MSM quality (PSE: pH<sub>i</sub><5,8, pH<sub>u</sub><5,4, WHC<50%, L\*>55; RSE: pH<sub>i</sub>=5,8-6,0, pH<sub>u</sub>=5,85-6,2; WHC=50-60, L\*=50-55; RFN: pH<sub>i</sub>>6,0, pH<sub>u</sub>=5,4-5,85, WHC=60-70, L\*=45-50; DFD: pH<sub>u</sub>>6,2, WHC>70, L\*<45).



## Results and discussion

The average meat yield in halves of cross-breed pigs determined with FOM device was 52,60% and 52,15%, and the difference between two groups is not significant ( $P>0,05$ ). The average meat yield determined by partial dissection is by 2% higher in both investigated groups of crossbreeds (54,21%, 54,48%) and the differences are not significant ( $P>0,05$ ), compared with the average meat yield determined with FOM device.

Table 1. Quality of halves, of multi-race pigs rested for different time in lairage, determined with FOM device and by partial dissection

| Lairage time | % lean meat (FOM) | % lean meat (partial dissection) |
|--------------|-------------------|----------------------------------|
| 0 hour       | 52,60 ± 5,03      | 54,21 ± 4,78                     |
| 48 hours     | 52,15 ± 3,87      | 54,48 ± 3,78                     |

<sup>NS</sup> $P>0,05$  \* $P\leq0,05$  \*\*  $P\leq0,01$

The results of investigation of technological parameters are presented in Table 2. It was found that the average  $pH_i$  of pigs slaughtered immediately after the arrival e.g. after 48 hours of rest in the lairage was 6,22 and 6,23, respectively, and these values respond to muscles of potentially normal quality ( $pH_i>6,0$ ) (Tomović, 2002). Higher average  $pH_u$  (5,91) was found in MSM of multirace hybrids which were resting for 48 hours, and responds to muscles of RSE quality. The average  $pH_u$  (5,81) found in MSM of pigs slaughtered after arrival points to muscles of normal quality ( $pH_u=5,4-5,85$ ). The average  $T_i$  of MSM from halves of pigs slaughtered without resting (42,2°C) was significantly higher compared to pigs rested for 48 hours (41,4°C). The average temperatures determined in MSM of multi-race hybrids are higher than the allowed temperature for meat with certificate ( $T_i=40^\circ\text{C}$ ) (Honikel, 1999, 2000). This finding indicates that the pigs were under great stress when slaughtered without resting, and that the stress was somewhat lower after 48 hours of resting. The stress induced fast glycolysis, which caused the increase of  $T_i$ , and this should reflect on the measured  $pH_i$  values, e.g. further decrease rate of  $pH_i$  values. Somewhat higher WHC (56,74%) was measured in MSM of pigs rested for 48 hours, however, not significantly higher than the WHC (56,25%) of MSM of pigs slaughtered without resting. On the basis of criterion for WHC, the investigated MSM were on the average of RSE quality (WHC=50-60%).

Regarding colour lightness  $L^*$  of investigated MSM, it can be noticed that MSM of pigs slaughtered without resting are significantly lighter ( $L^*=52,05$ ) ( $P\leq0,01$ ) compared to lightness of pigs rested for 48 hours ( $L^*=51,85$ ). According to our criterion for colour lightness  $L^*$ , the investigated MSM of pigs of both groups are of RSE quality on the average.

Table 2. Influence of lairage time of pigs on technological quality of *M. semimembranosus*

| Lairage time | $pH_i$      | $pH_u$      | $T_i$         | WHC          | $L^*$          |
|--------------|-------------|-------------|---------------|--------------|----------------|
| 0 hour       | 6,22 ± 0,30 | 5,81 ± 0,33 | 42,2 ± 0,74** | 56,25 ± 7,91 | 52,05 ± 5,96** |
| 48 hours     | 6,23 ± 0,23 | 5,91 ± 0,18 | 41,4 ± 0,58   | 56,74 ± 5,69 | 51,85 ± 4,94   |

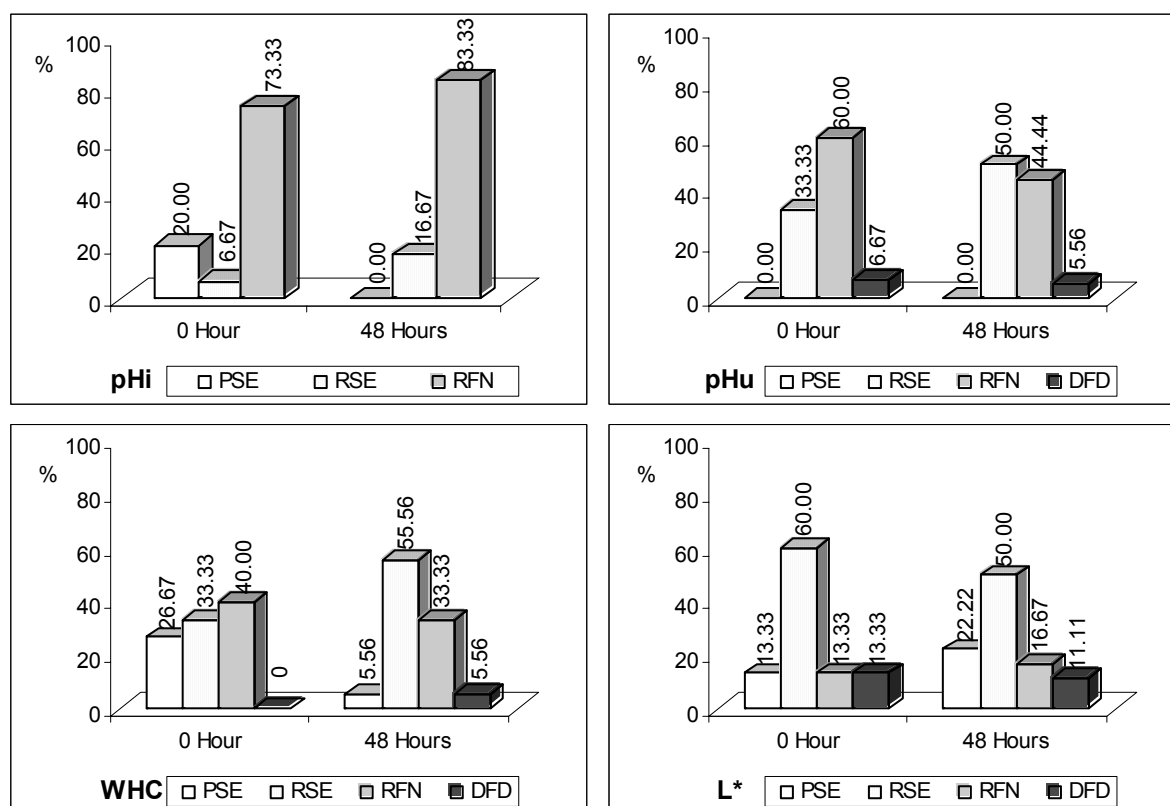
<sup>NS</sup> $P>0,05$  \* $P\leq0,05$  \*\*  $P\leq0,01$

The incidence of PSE, RSE, RFN and DFD quality of MSM of pigs rested for different time in the lairage is presented in Graph 1, on the basis of criteria for  $pH_i$ ,  $pH_u$ , WHC (%) and  $L^*$ .

According to the criterion for  $pH_i$  it was found that the potential incidence of MSM of RFN quality is higher (83,33%) in pigs which rested for 48 hours before slaughter, compared to pigs slaughtered without resting (73,33%). The obtained results show further that 60% of MSM of pigs slaughtered without resting and 44% of pigs slaughtered 48 hours after transport are of N quality, on the basis of criterion for  $pH_u$ . On the basis of criterion for colour lightness  $L^*$ , it was found that the highest incidence of MSM (60%) is RSE quality in pigs slaughtered without resting and 13,33% of PSE quality, and in pigs slaughtered 48 hours after transport the incidence of PSE and RSE quality is 22,22% and 50%, respectively. Further, according to criterion for WHC, 40% e.g. 33,33% of MSM of pigs slaughtered without resting e.g. after 48 hours of lairage time are of RFN quality. A number of multi-race hybrids (three-race) was slaughtered after 24 hours of resting and the investigations showed that the incidence of MSM of RFN quality was 78,6% for the same season (autumn) ( $pH_i$ ) (Natalija Džinić et al., 2004), 92,8% of RFN quality ( $pH_u$ ), 7,1% of RFN quality (WHC) and 7,1% MSM of RFN quality (lightness –  $L^*$ ). It can be concluded on the basis of the presented results that MSM



quality of pigs was even lower (WHC and L\*) when the resting time before the slaughter was 24 hours and regarding the results obtained in our investigations it is the most favorable to slaughter the pigs next to the arrival to the slaughter-house, e.g. that it is possible to decrease the incidence of lower quality meat prolonging the resting time to several hours (Malligan et al., 1998).



Graph 1. Incidence of different quality meat on the basis of criteria

## Conclusion

The average meat yield in halves of cross-breed pigs after resting for different time in the lairage (0 and 48 hours) determined by FOM device was 52,60%, e.g. 52,15% ( $P > 0,05$ ). The average meat yield in halves determined by partial dissection was 54,21% and 54,48 ( $P > 0,05$ ). The investigated MSM of crossbreed pigs slaughtered immediately after the arrival were of RFN quality, on the basis of criterion for pH<sub>u</sub>, and of pigs resting 48 hours in the lairage, according to the same criterion of RSE quality, on the average. The investigated MSM of both groups of crossbreeds was on the average of RSE quality, regarding the criteria for WHC and colour lightness – L\*. The incidence of RFN quality of MSM, on the basis of criterion for pH<sub>u</sub> is generally the highest 60% (without resting) and 44,44% (48 hours of resting). The incidence of RFN quality MSM is 40% e.g. 13,33% (without resting) e.g. 33,33% and 16,67% (48 hours of resting) according to criteria for WHC (%) and colour lightness – L\*.

## Acknowledgment

This work was supported by the Serbian Ministry of Science, Technologies and Development through the Project BNT.5.2.1.7101.B "Production of cooked ham"

## References

Bendall, J.R. and Swatland, H.J., 1988. A review of the relationships of pH with physical aspects of pork quality, Meat Science 24, 85-126



- Džinić, N., Petrović, Lj., Tomović, V., Manojlović, D., Timanović, S., Trišić-Ilić, S. i Mrđanov, J. 2003. Uticaj višerasnog ukrštanja i godišnjeg doba na kvalitet polutke i mesa svinja. *Savremena poljoprivreda*, 52, 3-4, 335-337.
- Džinić, N., Petrović, Lj., Tomović, V., Manojlović, D., Timanović, Vidarić, D. i Kurjakov N. 2004. Ocena kvaliteta polutke i mesa svinja rasa Veliki Jorkšir i Švedski Landras. *Biotehnologija u stočarstvu* 20 (1-2), 67-73.
- Eikelenboom, G., Bolink, A.H. and Sybesma, W. 1991. Effects of feed withdrawal before delivery on pork quality and carcass yield. *Meat Science*, 29, 25-30.
- Fortin, A., 1988. The effects of resting time on PSE in pork loins from hogs transported for two hours. *Animal Research Institute, Agriculture, Ottawa, Canada*
- Grandin, T., 1989. The effect of rest time on PSE in pork carcasses. Final Report to Monfort, Inc., Greely, CO.
- Grau, R. und Hamm, R. 1957. *Z. Lebens. Unters. Forsch.* 105, P.446.
- Hadživuković, S. 1991 *Statistički metodi*. Drugo prošireno izdanje, Poljoprivredni fakultet, Univerzitet u Novom Sadu, Novi Sad, 1-584.
- Honikel, K.O., 1999. Biohemijske i fizičko-hemijske karakteristike kvaliteta mesa. *Tehnologija mesa*, 40, 3-5, 105-123.
- Honikel, K.O. 2002. Nova dostignuća i sistemi za proizvodnju mesa visokog kvaliteta. *Tehnologija mesa*, 43, 3-6, 146-156.
- Lawrie, A.R. 1998. *Lawrie's meat science*, Sixth edition, Woodhead Publishing Limited, Cambridge, England
- Milligan, S.D., Ramsey, C.B., Miller, M.F., Kaster, C. S., and Thompson, L.D. 1998. Resting of pigs and hot-fat trimming and accelerated chilling of carcasses to improve pork quality. *Journal of Animal Science*, 76, 74-86.
- Rede, R i Petrović, Lj. 1997. *Tehnologija mesa i nauka o mesu*. Tehnološki fakultet, Univerzitet u Novom Sadu, Novi Sad, 1-512
- Robertson, A.R. 1977. *Color Research Applied*, 2, 7.
- Tomović, V. 2002. Magistarski rad. Tehnološki fakultet, Novi Sad.
- van der Wal, P.G., Engel, B. and Hulsegge, B. 1997. Causes for variation in pork quality. *Meat Science*, 46, 319-327.
- Walstra, P. and Markus, G.S.M. 1996. Procedure for assessment of the lean meat percentage as consequence of the new EU reference dissection method in pig carcass classification, *Research Institute for Animal Science and Health Report*, ID-DLO 96.014, 1-22, Research Branch, Zeist, The Netherlands
- Wariss, P.D., Brown, S.N., Edwards, J.E. and Knowles, T.G. 1998. Effect of lairage time on levels of stress and meat quality in pigs. *Animal Science*, 66, 255-261.
- Wittman, T.A., Forest, J.C., Morgan, M.T. and Okos, M.R., 1996. Electrical measurement for detecting early post-mortem changes in porcine muscle *Journal of Animal Science*, 74, 80-90.