EFFECT OF PRE-RIGOR SALTING ON THE WATER-BINDING CAPACITY OF BEEF

E. PUOLANNE and P. TURKKI

University of Helsinki, Institute of Meat Technology

Helsinki, Finland

INTRODUCTION

The use of hot boned beef has been more thoroughly studied than that of hot boned pork. The loss of ATP takes place faster in pork than in beef, but otherwise the reactions are similar (Hamm 1981, Nestorov et al. 1982). Moore et al. (1966), van Hoof (1974), Stilwell (1978) and Nestorov et al. (1982) did not find any marked differences between products made of hot processed pork and those made of cold processed pork. Mandigo et al. (1977) however, found a better product yield in hot processed pork products.

Puolanne and Terrell (1983) found that the water-binding capacity can be significantly enhanced by presalting pork with 2-4 % NaCl and 15 % added water within 1 h of stunning. The high water-binding capacity was retained in the meat even in cooked sausage, provided the salt content of the sausage was kept over 1.5 % NaCl when other ingredients were added to the mixture. Nestorov et al. (1982) concluded that the hot processing of pork (within 1.5 h post mortem) is hardly possible in the industry because of the time needed for slaughtering and meat inspection (including the trichina test).

The purpose of this study was to compare the water-binding capacity (WBC) of hot salted (less than 45 minutes post mortem) pork to that of cold salted (22 h post mortem) pork using the laboratory sausage method. Special attention was given to whether the disadvantages of fast glycolysing muscles (PSE) could be avoided by using hot boning and pre-rigor salting.

MATERIAL AND METHODS

Thirtysix pigs (carcass weight 70-72 kg) were obtained from a slaughterhouse. Six pigs at the time were taken for tests on each day of sampling. The pigs were slaughtered by the usual procedure, with the time from stunning to weighing averaging 25 minutes. Immediately after weighing the left hind leg was cut off and the M. gluteus medius (GM) was excised. The

samples were then quickly homogenized in a Moulinex Moulinette homogenizer (Moulinex, France) with 3 % NaCl. The time elapsed from stunning was no more than 40 minutes. The following day the GM muscles of the right-hand sides were excised and salted in the same way (post-rigor salting).

The pH values were measured directly using a Knick Portamess 55/pH meter (Knick Elektronische Messgeräte, FRG) with a meat electrode (Ingold type 10-404-3041, W. Ingold AG, Switzerland). The pH values of the left-hand GM muscles were measured immediately after homogenization (before adding salt), after adding salt and finally 22 h post mortem (salted homogenate). The pH values of the right-hand GM muscles were measured 45 min post mortem (pH_1), 22 h post mortem, after salting and after 22 h of salting. If the pH_1 value was $\leqslant$ 5.8 the pig was considered to be a PSE pig.

The WBC was measured using the laboratory sausage method of Puolanne and Ruusunen (1978). Each test was run in duplicate. The sausage mass contained 51.5 g of GM-salt mixture (50 g meat), 50 g pork back fat, 130 g water and 3.1 g NaCl. The salt content of the sausage mass was 2 %. Eighteen samples were processed without added phosphate and 18 samples with added phosphate (Curafos 0.15 % calculated as P_2O_5). The sausage mass was chopped in a Moulinex homogenizer, stuffed into a casing and cooked for 40 min at 75 °C to an internal temperature of 72 °C. After cooking the sausage was peeled and the excess water released was removed.

WBC was determined as the difference between the weight of the stuffed sausages (weight of casing excluded) and the weight of the cooked and peeled sausages after removing released water and jelly. No fat was released. These weight differences were subtracted from the 130 grams of water added to the original recipe and represent the weight of water retained by the sausage after cooking and chilling. The results were expressed as g water/100 g meat.

RESULTS AND DISCUSSION

The WBC of hot salted sausages without added phosphate was $\bar{x}$ = 92.8 ± 4.9 g water/100 g meat. The pH value of the meat at the time of presalting was $\bar{x}$ = 6.6 ± 0.3. The WBC of cold salted sausages was $\bar{x}$ = 53.7 ± 17.0 g water/100 g meat and the pH value of the meat $\bar{x}$ = 5.6 ± 0.2. The WBC of hot salted sausages with added phosphate was $\bar{x}$ = 107.7 ± 3.9 g water/100 g meat and the pH value $\bar{x}$ = 6.5 ± 0.3. In cold salted sausages the corresponding values were $\bar{x}$ = 104.5 ± 7.0 g water/100 g meat and pH $\bar{x}$ = 5.7 ± 0.3.

The linear regression between $\triangle pH$ *(* $\triangle$ *pH = pH at the time of hot salting -* pH_{22}*) and* $\triangle$ *WBC (* $\triangle$ *WBC = WBC hot salted meat - WBC cold salted meat) in the sausages without* added phosphate was WBC = 32.25 pH + 7.38; r = 0.530, and in the sausages with added phosphate WBC = 7.95 pH - 2.85; r = 0.615.

The effect of hot salting is not marked when phosphate is added, but without added phosphate a significant increase in WBC can be achieved. In the latter case the pH_{22} value seems to be very important (Figure 1). When the pH_{22} value was $\geqslant 5.85$, the decrease in WBC compared to hot salted samples was $\bar{x} = 9.5 \pm 3.1$ g water/100 g meat (N = 4), which was very much smaller than when the pH_{22} value was $\leqslant 5.8$ ($\bar{x}$ = 46.9 + 4.8 g water/100 g meat; N = 14). The number of samples with $pH_{22} \geqslant 5.85$ was too small to permit any definite conclusions, but this finding suggests that more research is needed in this area.

Only three PSE GM muscles were found in this study ($pH_1 \leqslant 5.8$), and there was no consistent indication that the formation of PSE could be prevented by very rapid pre-rigor salting.

Other studies conducted in our laboratory revealed that very rapid salting, within 1 h, is needed in most cases for a marked effect of pre-rigor salting. The beneficial effect of hot processing can be achieved only when the meat is salted before onset of rigor mortis. The temperature of the meat at time of salting is not important.

According to Nestorov et al. (1982) the time needed for slaughtering, including meat inspection, is at least 1.5 h, which probably prevents the effective use of pre-rigor salted pork. Nevertheless, more research is needed into the biochemistry of different muscles and into the technological prospects of using pre-rigor salting.

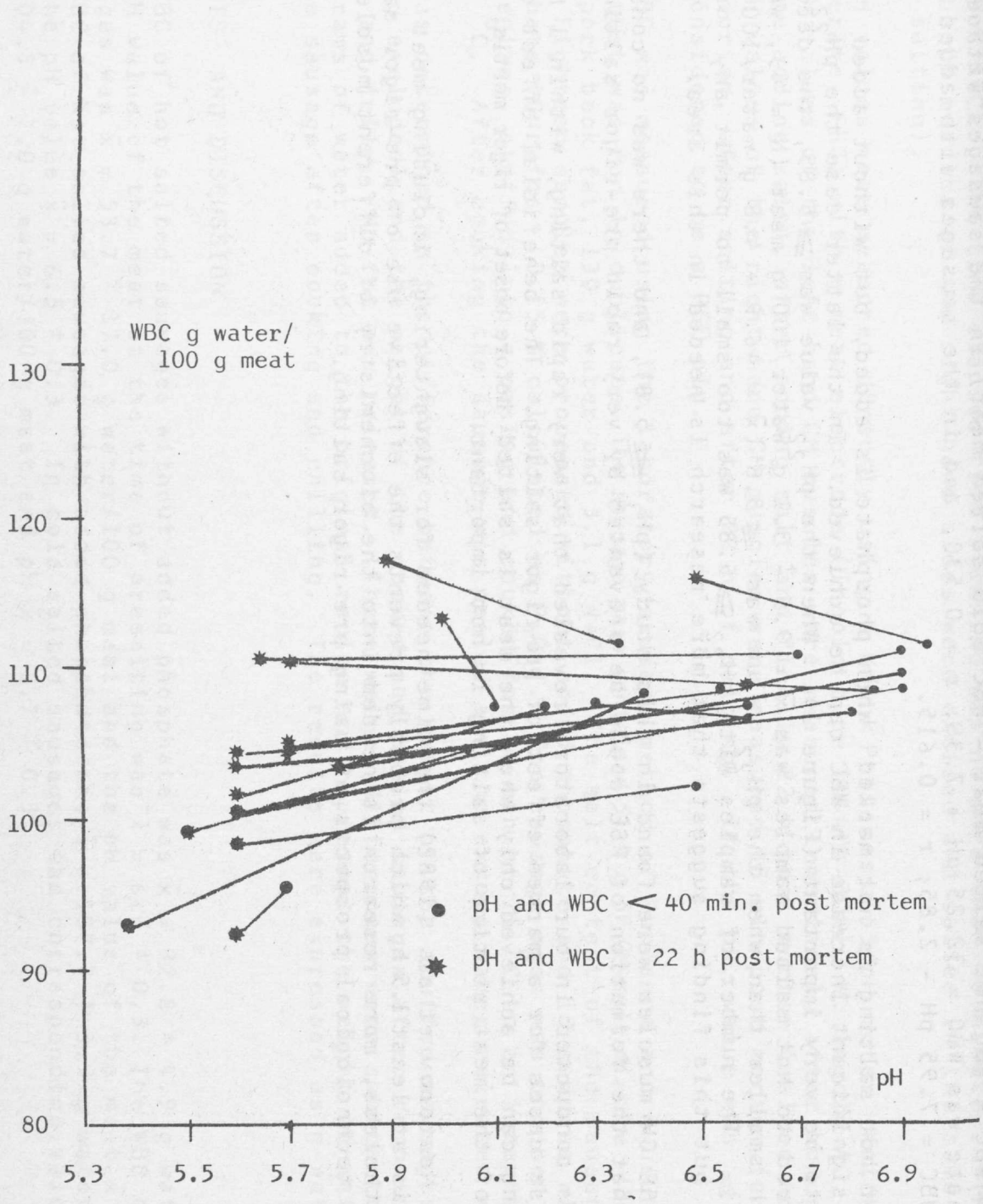

Figure 1A. pH value and WBC of porcine M. gluteus medius pre rigor and post rigor with added phosphate.

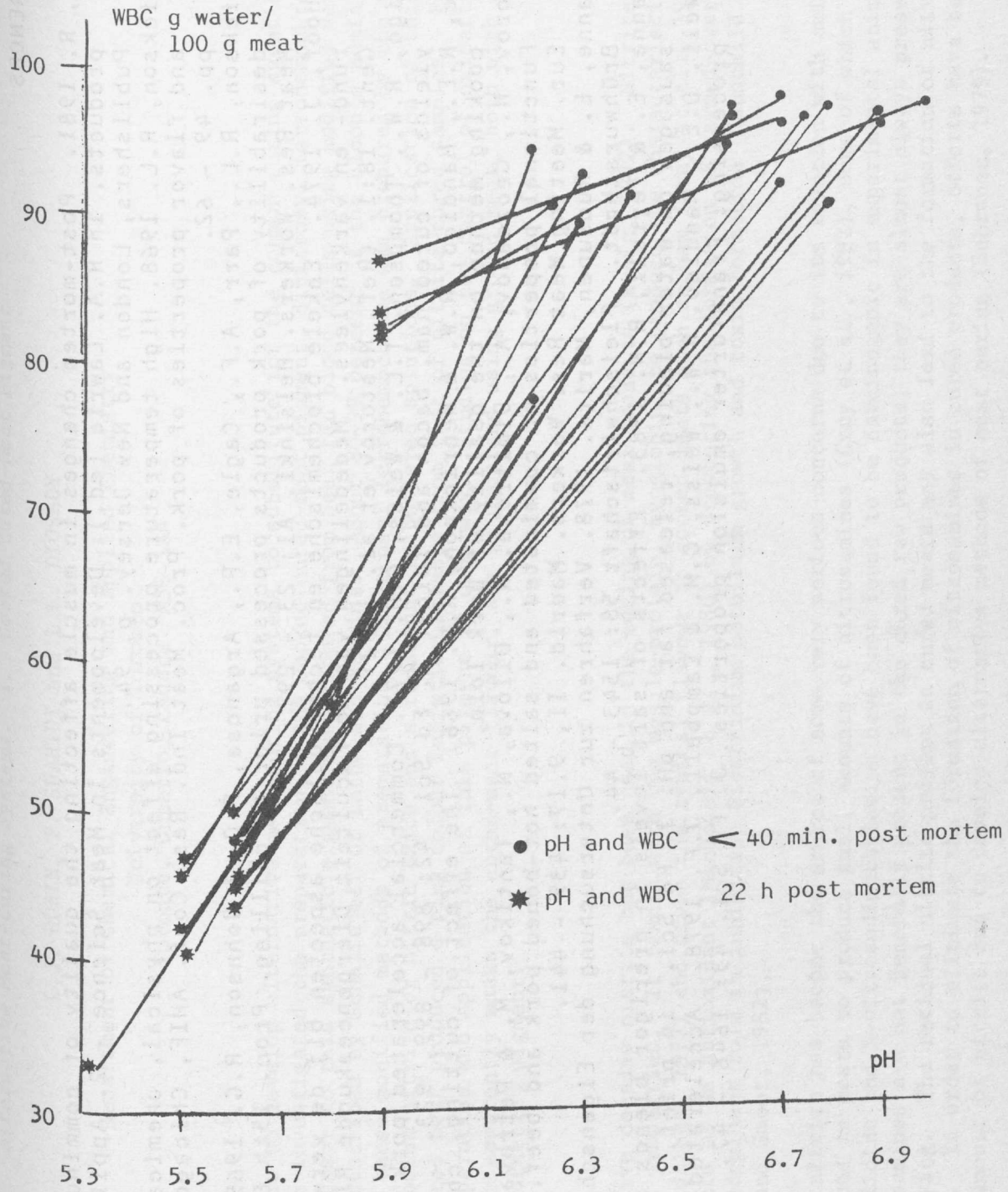

Figure 1B. pH value and WBC of porcine M. gluteus medius pre rigor and post rigor without added phosphate.

REFERENCES

Hamm, R. 1981. Post-mortem changes in muscle affecting the quality of comminuted meat products. In R.A. Lawrie (ed.): Developments in Meat Science - 2. Applied Science Publishers, London and New Jersey. p. 94.

Henrickson, R.L. 1968. High temperature processing effect on physical, chemical, microbial and flavor properties of pork. Proc. Meat Ind. Res. Conf. AMIF, Chicago. pp. 49 - 62.

Henrickson, R.L., Parr, A.F., Cagle, E.P., Arganosa, F.C. & Johnson, R.G. 1969. The desirability of pork products processed prior to chilling. Proc. 15th Eur. Meeting Meat Res. Workers. Helsinki. A1: 23 - 29.

van Hoof, J. 1974. Enkele biochemische en technologische aspecten bij de verwerking van rund- en varkenvlees. Mededelingen van de Faculteit Diergeneeskunde Rijksuniversiteit Gent. 18:1. (Ref. Nestorov et al. 1982).

Mandigo, R.W., Thompson, T.L. & Weiss, G.M. 1977. Commercial accelerated pork processing: yields of cured ham, bacon and loins. J. Fd Sci. 42: 898 - 899, 923.

Moore, R.E., Mandigo, R.W. & Henrickson, R.L. 1966. The effect of cutting, chilling, and cooking method on the quality of pork loin.

Nestorov, N., Grozdanov, A., Dimitrova, N., Dilova, N., Tantikov, M. & Petrova, D. 1982. Functional properties of comminuted and salted hot-boned pork and beef. Proc. 28th Eur. Meeting Meat Res. Workers. Madrid. II, 9.17: 439 - 441.

Puolanne, E. & Ruusunen, Marita. 1978. Verfahren zur Untersuchung der Eigenschaften von Brühwurstbrät. Fleischwirtschaft 58: 1543 - 44.

Puolanne, E. & Terrell, R.N. 1983. Effects of salt levels in prerigor blends and cooked sausages on water-binding, released fat and pH. J. Fd Sci., in print.

Stilwell, D.E., Mandigo, R.W., Weiss, G.M. & Campbell, J.F. 1978. Accelerated pork processing: Frankfurter emulsion properties . J. Fd Sci. 43: 1646 - 47.