

TECHNOLOGICAL ASPECTS IN PORCINE MEAT QUALITY

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SUMMARY

In recent years much emphasis has been directed in many countries towards the accelerated processing of meat, usually beef. The high rate of post mortem metabolism in pork limits the possibilities of exploiting the good technological properties resulting from pre rigor salting. Pork has excellent water-binding and gel-forming properties when pre rigor salted. Pre rigor salting must be completed within 1 - 3 h post mortem, depending on the muscle and on varying rates of post mortem metabolism in pig material. At least 1.8% NaCl must be added, usually with 10 - 20% water, to the minced meat. Pork fat does not cause any major problems in the hot boning and pre rigor salting of pork.

Pig material has probably changed considerably during the last few decades. The weight by weight ratio between muscles/bones and fatty tissue has increased along with intensive breeding and feeding. Our studies indicate that the composition of the muscles may be changing from red fibers more to intermediate and white fibers. This may not cause problems other than an increased tendency towards PSE-meat within both the pig population and individuals. We suggest that international cooperation would benefit the study of the fiber-type composition, physiological capacity of organs and endocrine systems in pig populations at different domestication levels.

INTRODUCTION

The technological quality of pork has not been studied worldwide as intensively as that of beef. Due to the less firm connective tissue and usually more severe heat treatment in pork, less effort has been devoted to the study of the tenderness of pork. In many countries, however, where winters or any other reason hampers the effective raising of beef animals, pork is much used in various whole meat and minced meat products, e.g. hams, bacon, sausages etc. This paper reviews the recent studies done in the field of pork meat quality in the Department of Meat Technology.

ACCELERATED PROCESSING

Accelerated processing i.e. cutting and eventually processing meat in the pre rigor -stage, provides several economical benefits. Much emphasis has been directed in many countries towards the accelerated processing of meat, but most of the research has been on beef. There has been an increased interest in pork in recent years (e.g. Reagan 1983, Hamm et al. 1984, Kim et al. 1985a, 1985b). Lean pork has a good or superior water-binding capacity as compared to lean beef, which is primarily due to the less firm connective tissue and as Linke (1976) has shown the higher pH-value of most muscles in the carcass.

When beef allows the use of pre rigor properties for about 6-8 hours, in pork these are lost in 1 - 3 hours, and in PSE-cases even faster. Unsystematic observations of the author as well as Dr. Honikel (personal communication) implied that in certain areas of the USA the post mortem

reactions run at approximately 1/2 - 1/3 the speed of Finnish or German pigs. Eventual reasons for that will be discussed below (see "Fiber types").

Fat is rather soft in pre-rigor (slaughter warm) pork. Liquid fat needs to be emulsified in order to keep it in the gel. Our tests (Puolanne and Turkki 1984) showed though, that fat is not released when it is added as a slaughter warm ingredient to the batter, in which lean meats are cold boned. This was observed in sausages made with or without added phosphate (Fig.1). (The higher amount of released fat in some cases are due to the very high proportion of added fat/lean. This does not mean a fat separation caused by the stage of fat).

In one of our first studies in this field (Puolanne and Turkki 1983) dealt with a very early (within 30-40 minutes) pre rigor salting (3% NaCl) of the *M. gluteus medius* (GM), which is a white muscle (Fig.2). Without added phosphate the WBC was 42% lower (14 samples) when salted 22 h post mortem than in the pre rigor stage. With added phosphate the respective difference was only 3%. This indicates that a substantial improvement in WBC can be obtained by pre rigor salting only when phosphate is not used. An interesting detail in the study was that when the ultimate pH-value of post rigor meat was over 5.85 22 h post mortem, the WBC decreased only 10% as compared with 50% for muscles where pH values were below 5.85 at the time of salting (22 h). This finding suggests, that at a high pH-value the actomyosin cross bridges formed might be different to the bridges formed at normal pH, because NaCl is able to break them without phosphate. This finding might need further research, because it should be borne in mind that the pH-value of many pork muscles have an ultimate pH-value of over 6.0. Jolley et al. (1981) showed that by hot boning pork carcasses the loss of WBC can be eliminated. As only three of the 36 pigs we had as an experimental material had PSE GM muscles (pH₁ 5.8), we were not able to study the eventual beneficial effect of hot boning on PSE meat as compared with normal carcasses.

The salt content in the pre-rigor salting is very important. Jolley et al. (1981) stated that at least 1.3% NaCl in beef is needed for utilizing the benefits of pre rigor salting. A previous study made by the author at Texas A & M University (Puolanne and Terrell 1983) demonstrated this for pork. The addition of salt and 15% water to minced pork within 90 min post mortem produced a good water-binding in meat even with 1% NaCl in the raw mass, however if a heat stable gel's to be obtained at least 1.5% (2%) NaCl is needed both in the pre rigor salting and in the sausage mass. (Tests were done with 0, 1, 2, 3 and 4% salt in the preblend and 1, 1.5 and 2.0% NaCl in the sausages) (Fig.3). This is very analogous to the use of phosphate, when also at least 1.5% NaCl for heat stable gel is needed (Puolanne and Ruusunen 1980).

In the opinion of the author accelerated processing of pork would best be achieved if the following points were observed: Pigs should be slaughtered by means of the best possible practice to avoid pre-slaughter stress. The slaughter process should be performed as soon as possible followed a rapid deboning of meat. Dehiding would accelerate the process substantially, and warming

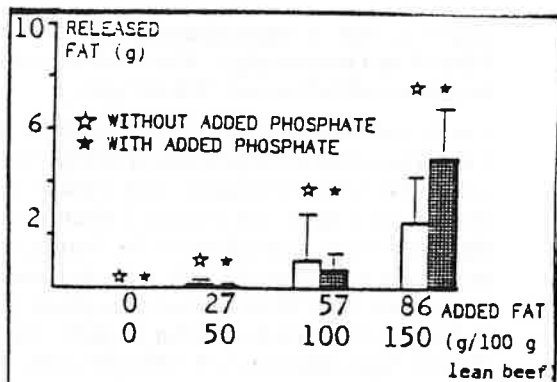


Figure 1.
The amount of released fat of sausages with various hot fat additions (Puolanne and Turkki 1984).

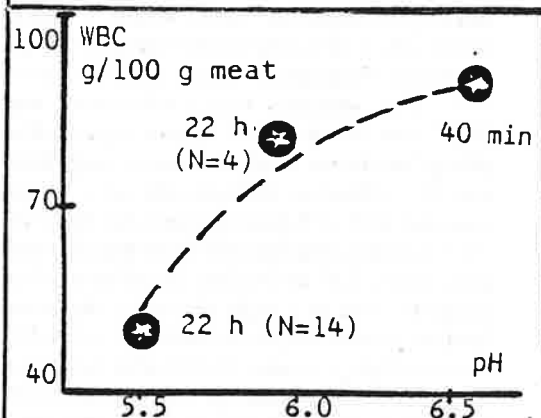


Figure 2. pH-value and WBC of GM muscles pre rigor and post rigor W/O phosphate (Puolanne and Turkki 1983).

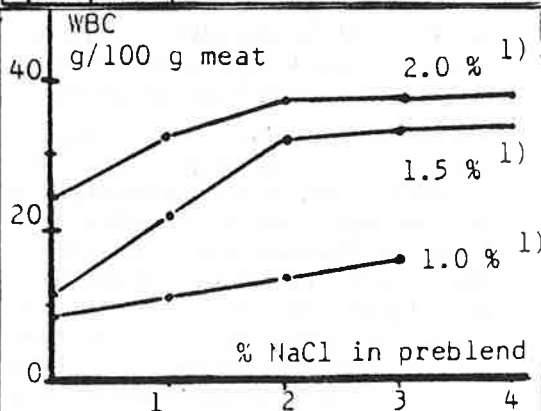


Figure 3. WBC in sausages stratified by levels of salt in sausages and in pre rigor blends. ¹⁾ salt % in sausage. (Puolanne and Terrell 1983).

caused by scalding would be avoided (See Honikel and Woltersdorf 1984, Honikel 1984). If some parts of the carcass are not to be processed they should be fast-chilled. Meat-to-be-processed must be chilled, minced and pre-salted immediately with 10-20% ice and at least 2%, normally about 3% NaCl. Care must be taken not to use too much NaCl (not over 5% calculated on the fat-free basis) in the high fat assortments to avoid

the denaturation of structural proteins. Pre-salted meat can be used immediately for processing, but it can be kept several days, depending on the temperature, which should be 0°C or less.

The technological benefits of pre rigor salting are well-known in the industry. This method is, however, used very seldom, due to the difficulties in process management. When plants have from the beginning been designed for hot boning, and advanced computer aided planning and management systems are used, it should be possible to control this long process from living animal to finished products.

COMPOSITION AND PROPERTIES OF PIGS

In Finland, due to the intensive breeding and changes in feeding patterns, pork has changed considerably. In 30 years the fat content has decreased by 30-40%. The average thickness of side fat has decreased from 30 mm in 1969 to 19 mm in 1979. The figures in Denmark were 27 mm in 1957 and 15 mm in 1972, respectively (Klint-Jensen 1988). The development has been very similar in most countries during the last few decades. This means, that at a given weight, the weight by weight ratio between muscles/bones and fatty tissue has increased. At the same time, according to the Finnish statistics, the growth rate has increased so that the pigs reach the slaughter weight in Finland two to three weeks younger than 25 years ago. It might be interesting to know whether this plays a role in the response of the pigs to stress. Many studies, including our's, indicate indirectly that the composition may have been changing from red fibers to intermediate and white fibers. Some results of our study are presented elsewhere in this Proceedings (see Ruusunen and Puolanne 1988). The primary reason for this might have been that the diameter of white fiber is larger than that of red fiber, which indirectly leads selection towards whiter muscles. This may result in an increased tendency towards PSE-meat within both the pig population and individuals. The technological quality, at a given pH-value, may not have been affected apart from the meat being paler in colour.

In many countries the pig material is very homogeneous. Therefore international cooperation would be very beneficial in obtaining genetically different populations for comparisons. We therefore suggest a joint international comparative study on fiber-type composition, physiological capacity of organs and endocrine systems in pig populations of different domestication levels. This would provide us with more knowledge for breeding and handling of pigs to produce pork of quality that the consumer wants, more effectively.

It has been shown, that the pH-value of living muscle can be for a short time be as low as 6.0 (Gardian 1984). Our preliminary results show (Kivikari unpublished) that the pH-value of some muscles is already lowered at the time of slaughter. This might mean that the rate of post mortem pH-decline need not necessarily have increased in all PSE-type cases, but the initial pH-value might have been low. If this is an important factor in formation of PSE or PSE-type quality in pork, the study of the handling of the pigs during the last few minutes before stunning should be very important. Although there is very much

information about these things in the literature, this subject remains one of the most fascinating areas for further research in this field.

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