Factors to decrease meat quality of pig before and after slaughter in Korea

[1]Kyong Hyun Bae, [1]Kyong hwan Kim, [1]Kyong Seon Lee, [1]Kyong Ok Lee, [1]Gil Boo Jin & [2]Seong Gu Hwang
Dodram Pig Farmer's Co-operative[1] & Hankyong National University[2]

ABSTRACT
The present study was undertaken to find out current problems to decrease pork quality with special emphasis on process before and after slaughter in Korea. It is evident that production and slaughter factors can be used to control technological quality traits. However, most of the present survey is based on studies investigating the influence of a pre-slaughter handling and slaughter procedures causing much drip loss.
In general, 12–15 h pre-slaughter fasting is common practice to reduce the risk of microbial cross contamination during slaughter but most of the pigs were not fasted before slaughter.
The two most widely used stunning methods are carbon dioxide (CO2) and electrical stunning in pigs. There were no slaughtering house which introduced carbon dioxide stunning in our country.
Time measurements of the Dodram slaughter line shows that the total retention time from sticking to entrance of the chilling room takes approx. 28 minutes, which is shorter than in a Danish slaughter process.
Due to that the pig handling before the killing is not optimal, the stress level of the pigs at Dodram is substantial and limits the possibility for a high meat quality level. Further on in the process it becomes difficult to repair poor meat quality, but a quick chilling process may to some extent reduce the unsuccessful pre-handling.
The heat extraction from the average pig carcass chilled from hot carcass temperature to 1.5°C - the approx. cutting temperature - is approx. 10,250 kJ of which 4,500 kJ equal to 44% of this heat extraction is coursed by evaporation from the carcass surface in the chilling equalising process.
The carcass chilling in the Dodram Blast Chilling process is a very slow process and must be improved to achieve optimal meat quality and chilling weight loss. The present air velocity is fine according to the test, but it is important that the air temperature starts at the lowest level and stays low until the carcass surface has attained the temperature below the freezing point. Then the process air temperature may be increased.
The efficiency of the Blast Chill tunnel evaporators is too poor. The compressor suction pressure was during the test 1 to 1.2 bar, equal to -37 to -41 °C. This indicates that either the total surface is too small or the heat transfer coefficient is too small due to limitations in the performance.

Keyword: meat quality, drip loss, pre-slaughter handling, fasting, resting, pig

Introduction

Pork quality covers inherent properties decisive for the suitability of the meat for further processing and storage including retail display. The main attributes of interest are water-holding capacity, colour, fat content and composition, oxidative stability and uniformity. Technological quality is a complex and multivariate property of meat, which is influenced by multiple interacting factors. These include breed, genotype, feeding, pre-slaughter handling, stunning, and slaughter method, chilling and storage conditions. The quality attributes fat content, composition, uniformity and oxidative stability are mainly affected by genotype and feeding strategy, while e.g. water-holding capacity and colour are affected by almost all the above mentioned factors. The eating quality of meat is still the most important factor for the consumers in relation to rebuying meat products. The single eating quality attributes of interest are appearance for colour, fluid retaining characteristics and fat content of meat and flavour depending on constituents in the fresh meat, e.g., fat composition, peptides, glycogen concentration, vitamin content, especially thiamine and vitamin E, etc., and the heat treatment of the product. Tenderness and juiciness are associated with the amount of moisture present in the cooked product and the amount of intramuscular fat.

It is known that transport of pigs may influence final ‹pork› quality. Thus, 8 h of transport compared to 0.5 h has been found to improve tenderness due to reduced glycolytic potential at the time of slaughter and subsequent higher ultimate pH (Leheska et al., 2003). In addition, van der Wal et al. (1997) found that 3 to 4 h resting period before slaughter was optimal with respect to ‹pork› quality.
Chilling rate has been found to influence tenderness development in meat and both too rapid and too slow chilling rates results in inferior tenderness development. However, moderate chilling rates, which slow down postmortem ‹processes› and hereby minimize muscle contraction, have been developed and implemented as a control tool in the production of beef and lamb meat in many countries.

Materials Methods

Results and Discussion

Two types of trucks are used; single and double decker trucks. The respective capacities are 44 pigs on the single deck truck and 65 pigs on the double decker truck.
The average live weight was informed to be 111 kg and the maximum weight is 125 kg and the minimum weight 86 kg.
The openings in the sides for ventilation are too low – pigs do not like to look to the surrounddings. The height from the floor to ceiling when loaded with pigs is very small, the backs of the pigs is very close to the angle bars in the ceiling.
The in transportation time from farm to slaughterhouse varies from ½ hour to 4 hours.
The flooring in the trucks is made in steel and some in aluminium with a non-slippery pattern. Saw dust was not used as spread on the decks. Steel flooring when wet is slippery and does not absorve shocks and does not provide insulation against noise from the hooves.
Bleedings in the hip joint was observed at the cutting plant, which could accur from leg spreading.
Pigs do not like edges, steps and shadows – this would not imply the pigs to move forwards, but instead make them to stop.
Some of the trucks do not have any siding to the surrounddings. We recommed to close the lower part of the individual decks – pigs do not like movement to the sides – that disturbe them. The Pigs coming out from the barn to the runway (when loading trucks) walks towards an open fencing, which pigs considers that they can pass and they don't understand that they should turn to the left.

The fencing should be closed and the runway should be approx. 1.5 meter wide.
With closed fencing the pigs' doesn't gets disturbed of what is happening outside the fencing.

The ramp was made in shettered steel plate, which makes noise when pigs walk on it – pigs do not like that, the same goes for when entering the car.

In vinter time in the morning when loading trucks we imagine that the outside light conditions are insufficient. The light towards the truck must be lighter; we recommend installing some light to make the pigs move more easily.
A lot of squealing from the pigs in the lairage is observed and the pigs are not resting – they are standing up or are fighting. There could be many reasons for this, e.g.:

- Stressed handling when driving towards the electrical stunner and when unloading
- High squealing from ungentle handling and unnecessary use of electrical prodder when driving the pigs to the pen strings or towards the electrical stunner

- Insufficient light conditions towards the electrical stunner
- The continiuous misting of the pigs and thereby reducing the body temperature too much. Only to be used in worm periods.
- Inappropriate design with 50-60 pigs in a group and no easy access for the operators to the pen strings without the operators is walking towards the pigs.
- Long period without feed, which might contribute to a reduction of the meat quality.

The drainage in the floor are positioned in each end of the pen strings – in this way urine has a long way to flow before it reaches the drain. Urine burnings has been observed all over the skin surface. A better design is to place the drains along one side in each pen string.
Unecessary force and disburbans was observed to be used when driving pigs out of the pens to the driveway and in the driveway. This goes for usage of electric pipes, showels and electrical prodders. Operators are not to be blaimed – they instead need the right tool box, as a right system and education.
The total bleeding time should be 6 minutes, at Dodram it is measured to 4 minutes and 40 seconds.

Furthermore,
it is known that pigs should not be fed immediately prior to transport, because pigs with full guts show higher mortality during transport (Warriss, 1994). Fasting has been investigated as a way of reducing muscle glycogen stores in pigs at the time of slaughter to increase $pH_{24\ h}$ and hereby improve WHC and colour. More than 24 h fasting is necessary to observe any significant differences in meat quality (Eikelenboom,Bolink, & Sybesma, 1991; Fischer, Augustini, & McCormick, 1988; Warriss, 1982 Wittmann, Ecolan, Levasseur, & Fernandez, 1994). Extended lairage does, however, raise other issues. The welfare of the pig may be compromised simply due to fasting as well as fighting in groups of mixed pigs (Murray, Robertson, Nattress, & Fortin, 2001).
Pre-slaughter stress can roughly be divided into longterm stress, such as on farm handling, mixing, loading and transport, and short-term stress, including lairage conditions and driving to the stunner. The two types of stress should not be considered as two separate things although long-term stress mainly leads to meat quality associated with that of DFD meat while short-termstress mainly leads to quality associated with RSE or PSE meat. Poor on farm handling increases the susceptibility to pre-slaughter stress (D'Souza, Warner, Dunshea, & Leury, 1998b). The negative handling resulted in significantly lower muscle glycogen stores early post mortem and lower $pH_{24\ h}$, as well as a higher incidence of PSE meat compared with pigs that were handled correctly
on the farm.

- dispatch arrangement at the farm
- loading facilities at the farm
- truck design
- education of truck drivers
- reception facility at the abattoir
- design of lairage
- education of operators in the lairage
- driveway design
- stunning facility
- sticking arrangement

- CO2 back-loader stunning unit

- Longer bleeding conveyor
- Check of the water distribution in the scalding shower unit
- Last de-hairing unit without recycling of water – fresh water above 40 ^{o}C is recommended instead
- Modified flame off singer 2 additional burner tubes
- Modified polish line + final drier
- Bung dropper
- Bagging of fat end
- Leaf fat and diaphragm loosener (Possibility in the future)
- Automatic splitting saw
- Steam vacuum suction units
- Knife sterilizers – 2 knife system and water temperature set to 82 ^{o}C
- Change of wet to dry slaughter concept

To keep a good meat quality, it is very important to chill the carcasses as soon as possible after slaughtering in a chilling process that is able to extract heat within an acceptable time.
Long retention time on a killing line will affect the meat quality in a negative direction. Time measurements of the Dodram slaughter line shows that the total retention time from sticking to entrance of the chilling room takes approx. 28 minutes, which is shorter than in a Danish slaughter process.
Due to that the pig handling before the killing is not optimal, the stress level of the pigs at Dodram is substantial and limits the possibility for a high meat quality level. Further on in the process it becomes difficult to repair poor meat quality, but a quick chilling process may to some extent reduce the unsuccessful pre-handling.
There were observed several incidence of PSE in the loin when inspecting the meat de-boning. Appearance of juice on the surface leaves the impression of poor water holding capacity. When pressed by a finger the finger collects free juice droplets. This tendency is particular noticeable around the bones. These observations very much emphasise the poor water holding capacity of the meat.
The impression of the loin meat colour is a colour graded towards the light end of the scale (pale). A reduction of the high stress level may change the colour positively, depending on it is a genetic expression or coursed by the treatment of the pigs from barn to cutting.

Two tests have been carried out in order to investigate in detail in which way the present chilling and equalization process affect the product temperature before cutting. The purpose of test No. 1 and 2 was identical.
Dodram informs that the average carcass live weight is 111 kg. The average slaughtered weight without head for carcasses is 82 kg.

References