THAWING OF PORK LOIN

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Abstract – Meat for further processing is often distributed frozen, and therefore, effects of freezing and thawing on pork loin quality are still very important. The rate of the freezing process is very important for the meat colour and exudate quality after thawing, whereas the rate of thawing has less influence on the amount of exudate after thawing. The thawed meat can be stored after thawing. This study shows that after four days, the colour will be lighter, and the amount of exudate will be higher, resulting in a lower yield and a risk of faster bacterial growth during storage.

Key Words – Exudate, freezing rate, meat colour

I. INTRODUCTION

Freezing of meat for preservation and prolonging shelf life has been used for decades, and the quality after defrosting is closely related to the freezing and thawing time. The most important quality parameters for thawed meat are drip loss, colour stability, process yield and shelf life. Meat contains approx. 70% water that during the freezing process changes from a fluid to a solid form, meaning that the freezing/thawing time of the water is very important for the process. Quick freezing will generate many small ice crystals, whereas slow freezing will result in a few nuclei and big crystals and therefore, rapid freezing is recommended. [1] demonstrated that a slow freezing rate caused higher drip loss for small pork samples, and correspondingly [2] found a lower thawing and cooking loss for fast frozen loins. The combination of the freezing and thawing rates was investigated in small meat samples and showed that a slow freezing rate in combination with longer thawing time gave higher drip loss compared with a fast freezing/thawing rate [1]. The thermal conductivity for fresh meat is 1/3 lower than for frozen meat, meaning that thawing needs more energy compared to freezing, and therefore it is recommended to remove any isolating material before thawing. Due to the quality of the thawed meat, the temperature at the surface had to be low (<5°C) to reduce bacterial growth and denaturation during both thawing and storage. It is well known that thawed meat does not have the same quality as fresh meat, and normally the recommendation is to use the thawed meat as fast as possible after thawing. It is shown previously [3] that storage/ageing of fresh meat will increase Water Holding Capacity. [4] also showed that storage for up to 7 days will decrease drip loss. The changes in meat quality during storage after thawing are not well documented, but will depend of the storage time, temperature and meat quality.

The aim of this study was to investigate the influence of freezing time, thawing time and storage conditions after thawing for pork loins' technological quality. The study was carried out in two trials. A) investigated two combinations of freezing time with two combinations of thawing time. B) investigated two thawing times with storage at two temperatures after thawing.

II. MATERIALS AND METHODS

Pork loins for the investigations were selected the day after slaughter from carcasses on a commercial slaughter line, based on slaughter weight (78-89 kg), meat content (58-64%) and ultimate pH (5.5-5.6) to ensure a minimal variation in the raw meat quality. The loins were deboned to a standard cut ready for export and wrapped before freezing. Trial A): left and right loins from 2*20 carcasses were used providing the possibility of making a paired comparison for fast and slow thawing depending on fast or slow freezing. For fast freezing, the loins were placed individually on the belt in an impingement freezer (ADVANTEC from FMC, FoodTech AB). After the core temperature reached -12°C, the loins were packed in boxes and stored at -18°C. The loins for slow freezing were packed in boxes and frozen at a commercial cold store. Slow thawing was in a chilling room at 5°C, and fast thawing was in a chilling chamber with a program in three steps: 25°C for 35 min, 15°C for 90 min, 5°C until the centre temperature reached 2°C, then 2°C. Trial B): 60 left loins were wrapped, packed in boxes and slowly frozen in a commercial cold store before storage for 10 months. The thawing process was as for Trial A. Half of the loins were thawed fast to 2°C, and the other half were thawed slowly to 5°C. For each thawing method, the loins were stored for 1 or 4 days after thawing at the same temperature as during thawing (2°C or 5°C). The following was measured after thawing/storage: The centre temperature (Testo 175T2), EZ drip loss [5], L*, a*, b*(measured by Minolta 300) [6] and Japanese Pork Colour Score

(JPCS) [6]. The loins were weighed before and after freezing/storage. The thawing loss was calculated as ((fresh weight – thawed weight)/fresh weight) *100 and the exudate during storage was calculated as ((thawed weight – storage weight)/thawed weight) *100. Students' t-test was used to analyse for significant differences between treatments. In both trials, continued temperature measurements (Testo 175T2) were made in the centre of two loins/treatments from packaging to final thawing.

III. RESULTS AND DISCUSSION

Important process parameters during freezing and thawing is the time from 3°C to -12°C during freezing (the water is frozen), and the time from -6°C to 2°C during thawing (the water is unfrozen). The figures in Table 1 show the time registration for the different combinations.

Table 1. Time for freezing and thawing and thawing loss for the different combinations.

Freez./Thaw. (Trial)	N	3 to -12°C (hour)	-6 to 2°C (hour)	Thawing loss
Fast/Fast (A)	20	3	10	1.6±0.6
Fast/Slow (A)	20	2	23	1.9±0.6
Slow/Fast (A)	20	90	15	7.7±1.3
Slow/Slow (A)	20	105	23	7.7±1.4
Slow/Fast (B)	30	100	8	8.9±2.2
Slow/Slow (B)	30	85	36	8.5±1.9

Table 2. Storage exudate and colour of a chop (average and SD) after storage for two different thawing processes (Trial B).

Process	Slow/fast		Slow/slow	
Storage day	1	4	1	4
Exudate %	1.7±0.7	4.1±0.7	3.2±1.1	5.5±1.4
L*	51.5±2.4	54.5±2.2	51.4±1.4	53.7±1.7
a*	6.0±0.7	5.2±0.5	5.6±0.6	5.7±0.7
JPCS	3.6±0.4	3.2±0.3	3.6±0.6	3.4±0.4

The difference in time to -12°C for the slow freezing process (up to 20 hours) can be explained, as the loins were packed in boxes and placed in a blast freezing tunnel, giving a more differentiated process, while the loins used for fast freezing were processed individually in the impingement freezer, resulting in a more equal process. The difference in thawing time was smaller, and the loins were removed from the boxes and only wrapped during the process, to ensure that all loins were thawed more equally. In Trial B after fast thawing, the core temperature was 2.5±0.2°C and after slow thawing 4.2±1.2°C. The result shown that the temperature in loin from slow thawing has a bigger variation. The freezing time was most the important for thawing loss ($p<0.001$), and fast freezing reduced the thawing loss and was like the result from [2]. The results from the 2 storage temperatures and up to four days of storage on exudate and colour are shown in Table 2. The exudate increased during time ($p<0.01$), and longer storage time led to more exudate from the loins ($p<0.001$). The level of the loss is at the same level as for fresh meat [3]. Longer storage time after thawing led to lighter meat, while the L-value increased significantly ($p<0.001$), and JPCS decreased significantly ($p<0.05$) after the loins had been stored for four days, with no changes in redness (a*).

IV. CONCLUSION

The freezing rate is more important than the thawing rate for the quality of pork loins after thawing. This result shows that fast freezing (2-3 hours to a core temperature of -12°C) will result in the lowest thawing loss. Thawing loss was not depended on the thawing time (up to 36 hours). Loins can be stored after thawing, but after four days, the colour of chops from the loin will be lighter and with a lower JPCS score. The total exudate will increase during storage.

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