

IMPACT OF THE FREEZING RATE ON THE QUALITY OF LOINS FOR FURTHER PROCESSING

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Keywords

Pork loins, freezing rate, thawing loss, process yield, colour, pH, water holding capacity.

Background

It is the general opinion that fast rates of freezing are associated with less drip during thawing (Lawrie, 1991). A previous Danish experiment proved that the thawing loss is approx. 1.5% lower in loins with a freezing rate of 25 hours than in loins frozen with a freezing rate of 40 hours. It is however, uncertain to what extent a reduction of the freezing rate from 36 hours to 24 or 12 hours respectively will affect the yield and the meat quality of the loins when these are further processed.

The freezing rate in this connection has been defined as the time it takes to reduce the temperature of a product from 5°C to a temperature at the product core of -12°C, corresponding to a counterbalanced product temperature of -18 to -20°C.

Objective

The purpose of this experiment was to check the impact of the freezing rate (it be 36, 24 or 12 hours) in relation to the thawing loss, colour and process yield in connection with processing of cooked, salted loins. The hypothesis put forward assumed that a short rate of freezing would reduce the thawing loss and increase the total yield of the processed product.

Methods

The pigs for this experiment (gilts and castrates) were chosen according to weight (71-77 kg), meat percentage (57.5-60) and pH₂ in loin (5.45 < pH₂ < 5.65). The selection took place over three days where a total of 42 pigs (2 x 42 loins) was selected each day of the experiment. After boning and packing, the loins were frozen in accordance with the procedures specified (36 hours, 24 hours or 12 hours). On each day of the experiment a direct comparison was made of the two freezing rates. Right/left loins from the same carcass went by turns through two actual freezing processes.

The loins were frozen in two specially designed 20" freezing containers. The freezing rate of 12 hours was achieved because these loins were wrapped in polypropylene bags only during the freezing whereas other batches of loins were packed in standard boxes (A12) as well. The loins were thawed and processed after cold storage for 2 to 3 weeks at -20°C. Thawing of the loins took place in a cabin and under control. The thawing time was approx. 10 hours (temperature of loin > 0°C) which must be considered relatively fast.

The loins thawed were weighed. Colour measurement of the raw meat was carried out with the Minolta equipment on slices of loin cut approx. 20 cm from the oyster piece. Samples for analysis of water holding capacity (solubility of proteins) were selected and minced. Colour measurement of the raw meat and analysis of water holding capacity comprised 3 x 44 loins that were not utilised for further processing. The remaining loins (3 x 40) were processed into a cooked, cured product with approx. 15% gain and with no other additives than phosphate.

Following losses/gains were registered per loin:

Thawing loss: $100 \times (\text{weight after boning} - \text{weight after thawing}) / \text{weight after boning}$

Total gain: $100 \times (\text{weight after cooking} - \text{weight after boning}) / \text{weight after boning}$

Colour of the finished product was measured by the Minolta equipment on slices cut approx. 15 cm from the oyster piece.

Data Analysis

Experimental data have been analysed in a t-test in which comparisons in pairs have been made of the three freezing processes. Subsequently the impact on yield and colour by the freezing rate was investigated in relation to both day of experiment and thawing batch. The investigation comprised a trilateral analysis of variance in which pH and water holding capacity were included as co-variances.

Results and Discussion

To secure a reasonably consistent raw material the loins for this experiment were selected according to *slaughterweight*, *meat percentage* and *pH*. There were no difference between the batches with respect to the three characteristics. The result of the analysis of *water holding capacity* confirmed that none of the loins of the three experimental batches were PSE.

Colour of the raw meat and of the finished product was measured by the Minolta equipment (Table 1). The values for brightness and b-value (yellowness) of the raw meat are lower with a freezing rate of 12 hours compared to 36 hours. The loins with the shortest freezing rate are thus darker and less yellow. The b-value of the finished product is highest at a freezing rate of 12 hours. These loins do thus give a more yellow colour to

the finished product than loins with a higher freezing rate which is in contradiction to the colour of the raw meat. It should be noted, however, that the differences in colour observed are significant only on a 5% level.

The thawing loss is significantly larger at a freezing rate of 36 hours compared to a freezing rate of 12 and 24 hours (Table 2). This experiment did not find significant differences in the thawing loss at freezing rates of 12 and 24 hours respectively. The total yield is the lowest at a freezing rate of 36 hours while the total yield does not deviate significantly whether the freezing rate is 12 or 24 hours. It was anticipated that the total yield would be the highest at the lowest freezing rate. In this connection it should be noted that the loins with a freezing rate of 12 hours were not packed in boxes during the freezing process. Part of these loins were dry at the ends which could be the cause of the lower process yield and consequently a lower total yield.

The Influence of the Freezing Rate on yields and colour was analysed in a 3-lateral analysis of variance in which pH and water holding capacity were included as co-variances. The analysis of variance proves that the freezing rate has a significant effect on the thawing loss, the cooking loss and the total yield, while it has no significant impact on the results of the colour measurements.

For all batches of loins pH varied between 5.45 and 5.65. According to the analysis of variance the thawing loss is influenced by the pH so that the higher the pH the lower the thawing loss. The total yield of this experiment has not been influenced by the pH. This is in accordance with the results of previous experiments, where the pH variance of the loins was 5.15-6.00, which proved that the pH influences the thawing loss, whereas the total yield in a production of a cooked, cured loin product to less extent is influenced by the pH of the raw meat (Andersson, 1994). The colour of the raw meat (b-value and brightness) is influenced by pH in as much as an increasing pH will reduce the brightness and the b-value whereas the colour of the finished product is apparently not influenced by the pH.

Water holding capacity is likewise influencing the colour of the raw meat (a- and b-values). It is uncertain to which extent yields and colour of the finished product are influenced by the water holding capacity since no analysis of the water holding capacity was made of the loins utilised for further processing.

Conclusions

A reduction of the freezing rate from 36 to 12 hours has apparently not much influence on the colour of raw meat and of finished products. The variances observed in colour are only significant on a 5% level. The freezing rate has an impact on the thawing loss as well as on the total yield of a cooked, cured loin product. The results of the yields indicate that the effect of a reduction of the freezing rate from 36 to 24 hours are relatively larger than the effect from an additional reduction from 24 to 12 hours.

The thawing loss is influenced by pH, while the total yield of this experiment was not influenced by the pH. pH is furthermore of importance to the colour of the raw meat whereas the colour of the finished product apparently is not affected by the pH.

Pertinent Literature

Andersson, M. (1994). Personal information.

Lawrie, R.A. (1991). Meat Science, Fifth English edition, Pergamon Press.

Data

Table 1 - Colour Measurement (Minolta) of Raw Meat and of Finished Product at the three Freezing Rates

	Freezing Rate					
	12 hours		24 hours		36 hours	
	Raw meat	Product	Raw meat	Product	Raw meat	Product
Brightness, ave.	52.5 ^a	73.3	52.8 ^{ab}	72.9	52.9 ^b	73.1
b-value, ave	5.19 ^a	5.78 ^a	5.53 ^{ab}	5.54 ^{ab}	5.45 ^b	5.52 ^b

Average figures with various letters attached indicate significant deviation

Table 2 - Yields obtained with the three Freezing Rates

	Freezing Rates								
	12 hours			24 hours			36 hours		
	No.	Ave.	sd.	No.	Ave.	sd.	No.	Ave.	sd.
Thawing Loss, %	40	4.4 ^a	1.5	40	4.7 ^a	1.7	40	5.5 ^b	1.7
Total Yield, %	40	1.8 ^a	2.8	40	2.9 ^a	2.4	40	1.2 ^b	2.3

Average figures with various letters attached indicate significant deviation