Testing the leaking-out theory: effect of sampling time on drip losses in pork

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Introduction and objectives

Kim et al. (1993) and Den Hertog-Meischke et al. (1994) reported that drip losses of pork samples diminished when sampling time was delayed. These authors suggested that this decrease could be explained by an improvement of the water-holding capacity of the meat, or alternatively by the leaking-out theory, i.e. fluid that was already lost by evaporation or drip cannot be lost anymore at a later stage. If the latter hypothesis applies, drip losses determined following delayed sampling times have little significance. However, in the studies mentioned above weight losses of the carcasses were not determined, meaning that the leaking-out theory could not be verified. The aim of the present study was to check whether the leaking-out theory may be responsible for decreased drip losses when sampling time was delayed. In addition, the effect of sample dimensions on drip losses was examined.

Materials and methods

The effect of sampling time was studied using two groups of each 16 carcasses. One carcass side was always used as a control. In one group, both carcass sides were cut at 1 day post mortem (pm) into the primal joints loin, ham, shoulder and belly. These joints of one side were stored in the chilling room for 5 more days. In the second group whole carcass sides were kept in the chilling room for 5 more days. The weight losses of these joints and carcass sides were determined after 24, 48 and 120 hours. In addition, following measurements were carried out in the *longissimus* muscle: pH 45 minutes, 1 and 6 days pm; internal reflection with the FOP device and conductivity with the PQM meter at 1 and 6 days pm.

From the control and experimental sides, samples of the *longissimus* muscle were taken at 1 and 6 days pm for determination of drip losses (percentage weight loss of the muscle sample without external fat and bone after hanging for 48 hours in a plastic bag in the refrigerator; Honikel, 1987), colour (CIELAB values), fluid uptake by the filter paper method (Kauffman et al., 1986), thaw and cooking losses, shear force following cooking for 1 hour at 75°C and sarcomere length. Determination of drip losses was carried out in twofold, the dimensions of one sample being standardised as much as possible (2.5 x 5 x 5 cm).

Results and discussion

Weight losses of joints and carcass sides

A non-linear increase in weight losses with chilling time was found for the primal joints and the carcass sides (Table 1). In addition, approximately 2% weight losses occurring during the first day pm must be considered. Weight losses of the ham joint were approximately half those found in the loin and belly joint, whereas those of the shoulder joint were intermediate.

Drip losses

By standardising the size of the samples, the mean weight was reduced to one half of the original weight and the variance was reduced to one third. Mean drip losses were higher for standardised samples compared with normal samples, which may probably be explained by the freshly made surfaces and by the increase in surface/weight ratio of the samples following cutting and standardisation. After extended storage, a mean decrease in drip losses of 6.4% and 5.6% was found for standardised and non-standardised samples respectively. Hence, sampling time has a large effect on drip losses according to Honikel's method.

Drip losses originate from muscle tissue. Therefore, weight losses of the loin joint and of the carcass sides were recalculated considering the amount of lean meat in it. It was further assumed that fat and bone did not loose weight during storage. For the loin joint (group 1), a lean meat percentage of 77% was taken into account. For the carcass sides, the lean meat percentage deduced from the dissection using appropriate regression equations developed earlier at our laboratory was used. The weight losses calculated in this way correspond well with the observed decreases in drip losses of the meat samples (48 hours refrigerator). Hence, the decrease in drip losses following a delayed sampling time may probably be explained by the leaking-out theory, i.e. fluid that was lost once cannot be lost anymore at a later stage.

On the other hand, low correlation coefficients were found between the calculated weight losses of the joints or carcass sides and the decreases in drip losses in standardised and non-standardised samples due to the extended storage. Apparently this does not confirm the leaking-out theory. However, from the correlation coefficients between the drip losses and their respective decreases following extended storage, it appears that the decreases in drip losses are more related to the drip losses themselves of the samples taken at 1 day pm than to those of the samples taken at 6 days pm. Samples taken out early pm that have high drip losses are originating from carcasses with an intrinsic low water-holding capacity. One may expect these carcasses to loose relatively more moisture during a period of extended storage, so that relatively lower drip losses may be found after storage, and by consequence also larger decreases in drip losses are found. Hence, larger weight losses of carcass sides may correspond with larger decreases in drip losses of samples taken at a later stage pm, confirming again the leaking-out theory. The reason why this is reflected in the mean values of moisture losses but not in the correlation coefficients may be due to cumulating errors following multiple weighing.

In general, the correlation coefficients between weight losses of carcasses or loin joints and drip losses of meat samples were rather low, meaning that weight losses of carcasses or joints have little predictive value for water-holding capacity of the meat and vice versa. This is in contrast to the study of Lopez-Bote & Warriss (1988).

Effect of ageing on other meat quality traits

Fluid uptake by the filter paper method was significantly lower for the samples of group 1 taken at 6 days pm compared with 1 day pm, but not for the samples of group 2. Thaw losses were 4.7% and 3.0% lower in group 1 and 2 respectively. On the other hand, almost no difference in cooking losses was found between samples taken at 1 and 6 days pm. The ultimate pH value in the loin was slightly but significantly higher for the samples taken at 6 days pm compared with 1 day pm in group 2 (+0.07), but not in group 1. However, this increase is probably too small to explain the decrease in drip losses that were found. Conductivity values were significantly higher in the loin 6 days pm compared with 1 day pm in group 2 (+2.6), but were also not different in group 1. Internal reflectance values in the loin were significantly higher in both groups at 6 days pm compared with 1 day pm (+7.2 en +12.4 in group 1 and 2). A significantly higher colour a* value was found in samples taken at 6 days pm compared with 1 day pm in both groups (+1 en +0.7 in group 1 and 2). The colour L* value (+1.5) and b* value (+0.6) were significantly higher only in group 2. By sampling at 6 days pm instead of 1 day pm, only a slight decrease in shear force was found of 1,8N in group 1 and 3,9N (significant) in group 2. There was no effect on sarcomere length. Ageing of pork carcasses had thus little or no effect on other meat quality attributes than drip losses.

Conclusions

In pork, drip losses of muscle samples decrease when samples are taken at a later time pm. These decreases may be explained by the weight losses of the carcass sides or joints that have occurred during the storage period. The leaking-out theory could thus be confirmed, and ageing thus probably not improve the water-holding capacity of pork. Ageing for 6 days instead of 1 day had also little or no effect on other meat quality attributes. Standardising the muscle sample size may increase measured drip losses.

References

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Table 1 Mean weight losses (%) of carcass sides and joints during chilled storage from day 1 to day 6 pm (standard deviation)

Weight loss (%) after	24 hours	48 hours	120 hours
group 1 (n=16)			
loin	1.50 (0.20)	2.73 (0.35)	5.59 (0.56)
ham	0.77 (0.13)	1.40 (0.26)	2.87 (0.52)
shoulder	1.10 (0.25)	1.89 (0.28)	3.52 (0.35)
belly	1.56 (0.24)	2.83 (0.31)	5.54 (0.50)
carcass side #	1.22 (0.14)	2.19 (0.21)	4.38 (0.37)
group 2 (n=16)			
carcass side	1.18 (0.21)	2.03 (0.24)	3.91 (0.26)

Calculated value

Table 2 Mean drip losses # (%) according to sampling time and sample size (standard deviation)

Sample size	Non-standardised		Standardised	
Sampling time	1 day pm	6 days pm	1 day pm	6 days pm
group 1 (n=16)	9.6 (1.6)	3.0 (1.1)	12.5 (1.7)	4.3 (1.8)
group 2 (n=16)	8.3 (1.9)	3.7 (0.8)	10.9 (2.5)	6.3 (1.2)

storage in plastic bag in refrigerator for 48 hours