INFLUENCE OF TWO AGEING METHODS ON MFI, OSMOLALITY AND SUBSEQUENT MEAT TENDERNESS

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SUMMARY

Sixteen Simmental heifer carcases were kept at 10 °C until 10 hours *post mortem*, and thereafter at 0 °C until 48 h *post mortem*. Prior to ageing samples were taken from the *Mm. longissimus thoracis et lumborum* (LTL), *M. gluteus medius* (GM) and *M. psoas major* (PM) for osmolality and MFI determinations. Hind quarters were either aged on the hook (OH) for another 12 days at 0 °C, or dissected into wholesale cuts, deboned and vacuum packaged and aged for an additional 12 days at 0 °C. Fourteen days *post mortem* samples of the OH and VP aged LTL, GM and PM were taken for sensory evaluation, shear force measurements, osmolality and MFI determinations.

OH ageing resulted in more tender LTL and GM, with no differences in the PM. MFI values and osmolalities increased from 48 h to 14 days *post mortem* in both the LTL and GM, with no differences in the PM. OH tended towards higher MFI values. Osmolalities were higher in OH samples. The perception that OH ageing results in more tender meat than VP ageing was substantiated. Osmolalities parallelled the changes in tenderness and MFI values well.

Introduction

The osmolality of muscles is implicated as one of the factors influencing *post mortem* ageing. Generally on the hook (OH) ageing is perceived to result in more tender meat than vacuum packaged ageing (VP). OH ageing results in more moisture loss than VP ageing as a result of evaporation. Also indications exist that osmolality of a muscle (Ouali, 1990) may influence the improvement of tenderness during ageing. Therefore it may be perceivable that OH ageing may indeed result in more tender meat than VP ageing.

Materials and methods

Sixteen Simmental heifers with an average carcase mass of 288 ± 45 kg were slaughtered after captive bolt stunning. The carcases were kept at 10 °C until 10 hours *post mortem*, and thereafter at 0 °C until 48 h *post mortem*. The right hind quarter was aged on the hook for another 12 days at 0 °C, whereas the left hind quarter was dissected in wholesale cuts and deboned. Pre-ageing samples were taken from the *Mm. longissimus thoracis et lumborum* (LTL), *M. gluteus medius* (GM) and *M. psoas major* (PM), vacuum packaged and frozen for subsequent osmolality and MFI determinations. The remaining LTL, GM and PM were VP aged for an additional 12 days at 0 °C in the same chiller as the OH aged hind quarters. Fourteen days *post mortem* steaks were cut from the OH and VP aged LTL, GM and PM for sensory evaluation and shear force measurements, and a further sample taken which was vacuum packaged and frozen for subsequent osmolality and MFI determinations.

Only the last ten carcases (302 ± 44 kg) were available for the MFI and osmolality determinations. MFI values were determined according to a modified method of Culler *et al.* (1978). The frozen samples were thinly sliced with a knife. After removal of any visible fat and connective tissue, the sample was scissor minced. About 3 g of the minced sample was homogenised for 30 sec. in 50 ml 0.02 M potassium phosphate buffer (pH 7.0) containing 100 mM KCl, 1 mM $MgCl_2$, 1 mM EDTA and 1 mM NaN_3. The blade of the Bühler HO 4 homogeniser was turned around in order to fragment the myofibrils with the blunt edge rather than to cut them with the sharp edge at 20000 rpm. The homogenate was centrifuged (4 °C, 1000 x g, 15 min). After discarding the supernatant the pellet was resuspended in 50 ml buffer, and re-centrifuged. The

second supernatant was discarded and the pellet resuspended in 10 ml buffer before filtration through a 1000 µm polyethylene strainer under a light vacuum. An additional 5 ml buffer was added to facilitate the passage of myofibrils through the strainer before subsequent filtration through a 250 µm polyethylene strainer under a light vacuum. The protein concentration was determined using the Biuret method (Gornall *et al.*, 1949 as cited by Bailey, 1967). The filtrate was diluted to roughly 1.5 g/l protein and the exact protein concentration determined using the micro-biuret method (Bailey, 1967). Thereafter the sample was diluted to 0.5 g/l protein, and the protein concentration of this dilution determined using the micro-biuret method (Bailey, 1967). Only if the concentration was 0.5 ± 0.05 was the absorbance of the sample suspension determinded at 540 nm. The MFI value was this absorbance multiplied by 200.

The osmolality of the exudate in the bag after thawing ($Osmol_{ex}$) was determined in duplicate with an Osmomat 030D (Gonnotec) osmometer using 50 µl of the exudate. The osmolality was also measured of the fluid after scissor mincing of a ca. 60 g muscle sample and centrifugation at 100 000 x g for 20 min ($Osmol_{fl}$) (Ouali *et al.*, 1993).

The steaks were prepared for sensory evaluation and shear force measurements as follows: the 2.5 cm thick steaks were covered in aluminium foil and heated on a doubled sided contact grill (235 °C) to an internal temperature of 70 °C.

Paired samples of OH and VP aged muscles were served hot to a six member trained taste panel. The taste panel had to choose the sample which was most acceptable in each of the characteristics juiciness, tenderness and flavour. The remaining portions of the steaks were kept in a refrigerator (4 °C) overnight for shear force measurement which was carried out the following day.

About five 12.5 mm cores were taken from the remaining steaks parallel to the fibre direction for shear force measurements. Shear force was measured perpendicular to the fibre direction using an Instron Universal Testing Machine (Model 1140) with a Warner Bratzler attachment.

The sensory evaluation results were analysed according to DIN 10 954. Shear force measurements, MFI and osmolality were interpreted using analyses of variance (STATGRAPHICS V5.0).

Results and Discussion

The OH aged LTL and GM samples were evaluated by the taste panel to be more tender ($P \leq 0.05$), although no differences were found in tenderness between the OH and VP aged PM samples ($P > 0.05$). Grouping the shear force values of all three the muscles it was clear that the OH samples were found to be more tender than those of the VP aged samples ($P \leq 0.01$). These differences are illustrated in Figure 1.

Regarding MFI values and osmolalities the LTL and GM showed very similar treatment responses whereas the PM showed no response (Tables 1 and 2). As a result two-way analyses of variance were performed using the LTL and GM (muscle x treatment) and one-way analyses of variance for the PM.

No significant differences were found between the LTL and GM for MFI, $Osmol_{ex}$ or $Osmol_{fl}$. However, it was found that the MFI increased significantly from 48 h to 14 days *post mortem*. Also the MFI values of the OH samples were higher than those of the VP aged samples, albeit not significantly so ($P > 0,05$). The same tendency was recognised with the osmolalities. The osmolalities increased from 48 h to 14 days *post mortem*, and the osmolalities ($Osmol_{ex}$ and $Osmol_{fl}$) of the OH samples were significantly ($P \leq 0,05$) higher than those of the VP aged samples, which is consistent with the MFI results, sensory tenderness ratings and shear force values.

No significant differences were found in the PM regarding MFI and osmolality ($Osmol_{ex}$ and $Osmol_{fl}$) from 48 h to 14 days *post mortem*. This is another indication that the PM behaves totally different than would be expected. This was also found in results of the samples evaluated using SDS-PAGE electrophoresis (Heinze and Brüggemann, 1994). The densitogrammes of the PM showed little change in the different myofibrillar bands between 48 h and 24 days post mortem samples, whereas significant changes were found in the LTL and GM. It has already been shown before that the PM has very low calpain activities (Olson *et al.*, 1977) which may result in lower ageing rates.

Winger and Pope (1980-81) suggested that the effects of osmotic pressures on enzyme activity, protein solubility and other biochemical processes occurring in the muscle should not be overlooked. To this effect Ouali (1990; 1992) has indicated that the osmolality of the muscle may have a very important role in *post mortem* ageing. A high osmolality would increase the solubility of proteins, therefore making them more available for enzymatic degradation. The $Osmol_{fl}$ were higher than those of the $Osmol_{ex}$ values, and this could probably be attributed to higher levels of nucleotides and proteins within the muscle cells which also affect the osmolality level which could not migrate to the exudate as freely as possibly the inorganic- ions.

Conclusions

The MFI values and osmolalities increase with ageing from 48 h to 14 days *post mortem* in the LTL and GM, but not in the PM. OH ageing increases the tenderness of the LTL and GM, but not of the PM. These findings were generally parallelled by the MFI values and osmolalities, especially the $Osmol_{ex}$ in the LTL and GM. This would imply that differences in the osmolality of different muscles and during ageing may have an effect on the tenderness of meat, and also the ageing rate.

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