# EARLY POST MORTEM PREDICTION OF MEAT TENDERNESS

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## Background

Identification of markers that can be used for an early post mortem (PM) prediction of the tenderness development in meat has for long been of high priority. Considerable evidence suggest that the activity of muscle proteolytic enzymes regulates the rate of protein degradation *in vivo* and the rate and extent in the subsequent tenderness development which occurs PM. This means that factors affecting the rate of protein degradation *in vivo* at the time of slaughter may also affect the final tenderness of meat. Thus, markers for quantification of muscle proteolysis early PM provide a potential tool for improving tenderness by selection of carcasses early PM or by differentiated handling of carcasses.

## Objectives

In this study the aim was to develop a method to detect changes in the peptide profile in meat early PM to be used as a marker for the tenderisation potential of meat.

## Methods

A sample of the *longissimus dorsi* muscle from 37 pigs was excised 15 minutes after slaughter, frozen in liquid nitrogen and afterwards stored at -80°C until analysis. The frozen meat samples (approx. 3 g) were vacuum packed and transferred to a water bath at 25°C. This procedure insured an almost immediate thawing of the meat. The samples were incubated at 25°C for 3 hours 45 minutes to model changes on the carcass the first 4 hours after slaughter. Peptides were extracted from the meat using 3% perchloric acid (Feidt et al., 1998) and afterwards separated and quantified by capillary electrophoresis (CE). A P/ACE system 5010 CE instrument mounted with a diode array detector was used to separate peptides with the following run parameters: 12 second injection, separation at constant current (250 mA) with 300 mM boric acid (pH 9.00, adjusted with 10 M NaOH) at 20°C. An uncoated capillary of 97 cm total length and an inner diameter of 100 µm was used. Peaks were detected at 200 nm. Samples for tenderness measurement were taken from the carcass 24 hours after slaughter and stored at –20°C until analysis. A standard Warner-Bratzler shear force (WBSF) measurement was used for the tenderness determination. On basis of the peak areas a partial least squares (PLS) model to predict the WBSF measured 24 hours PM was developed using the Unscrambler software with full cross validation and weighing all variables with 1/SD (Esbensen, 2000) .

## Results and discussion

The CE procedure separated approximately 50 different compounds with the majority presumably originating from peptides ranging in size from di-peptides to 13 kDa polypeptides. Changes in the peptide profile were followed from 1 hour PM to 96 hours PM (figures 1 & 2). Several peaks either increased or decreased during storage which is demonstrated in figure 2. These changes might be due to proteolytic activity in the meat, i.e. decreasing peaks representing degradation of larger polypeptides and increasing peaks representing accumulation of protein fragments originating from degradation of proteins and larger polypeptides. If proteolysis is ongoing early PM there is possibly a correlation between the peptide profile obtained early PM and the tenderness/WBSF measured later PM. On the basis of the peak areas obtained 4 hours PM a PLS regression model was optimised to predict the WBSF after 1 day storage. A model using 4 PLS-components resulted in a correlation of 0.83 between the measured and the predicted WBSF (figure 3). This correlation demonstrates that it is possible soon after slaughter to extract information from the meat which can predict the development in tenderness that occurs during storage, i.e. the peptide profile obtained with the CE procedure is a multivariable marker for the tenderisation potential of meat.

## Conclusion

A method using capillary electrophoresis was developed. Approximately 50 different compounds were observed and the amount of some changed dramatically early PM. Using a PLS regression model the peptide profile obtained 4 hours PM correlated ($r = 0.83$) to the tenderness measured 24 hours PM.

## Reference List

Esbensen, K. H. 2000. Multivariat data analysis. CAMO ASA, Oslo, Norway.
Feidt, C., J. Brun-Bellut, and E. Dransfield. 1998. Liberation of peptides during meat storage and their interaction with proteinase activity. Meat Science 49:223-231.

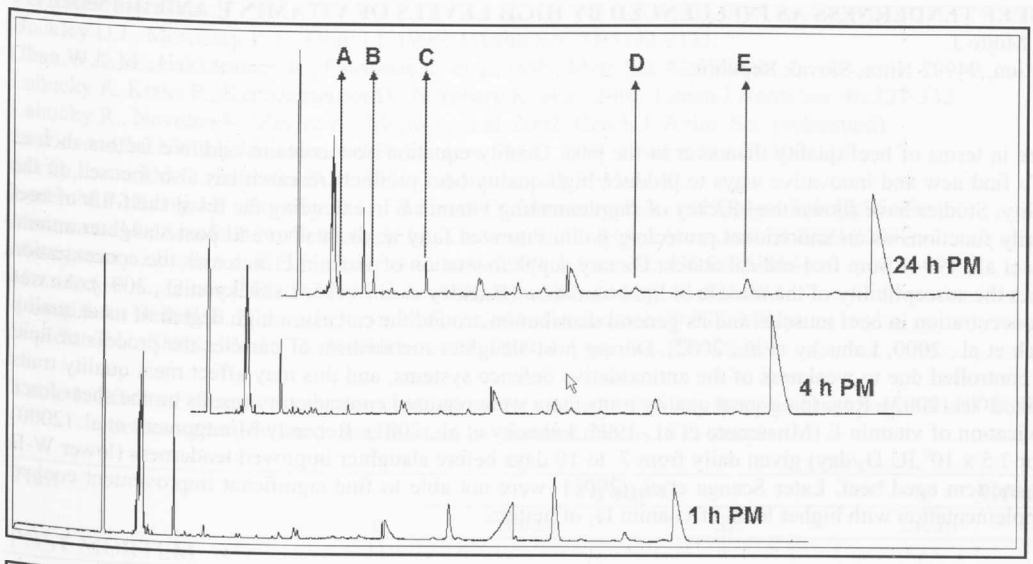


**Figure 1. Electropherograms obtained from samples 1, 4, and 24 hours post mortem.**

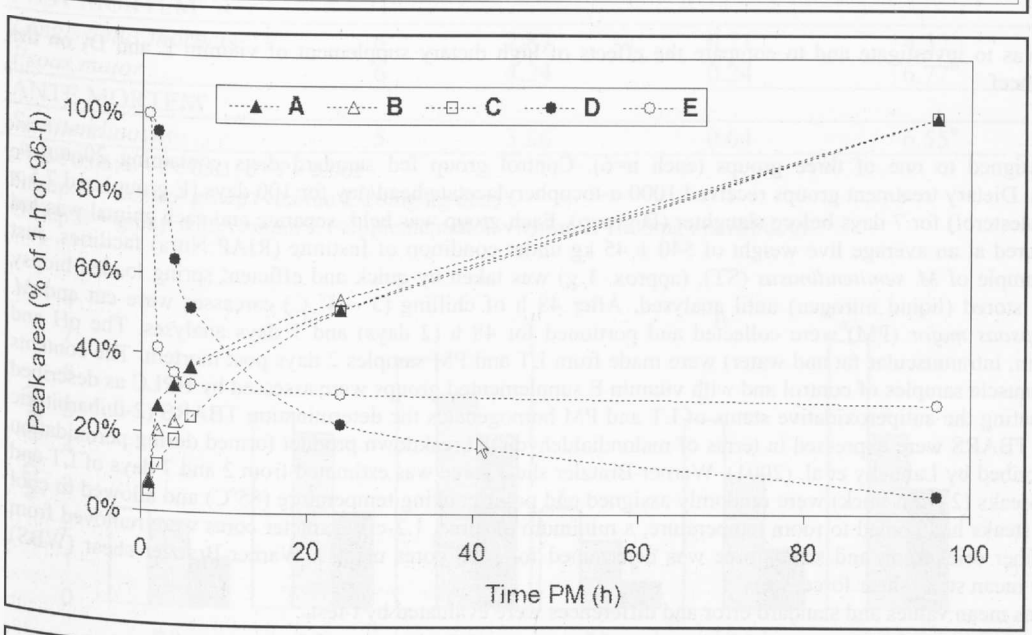


**Figure 2. Development of five major peaks during 4 days ageing of meat.** The peak areas are normalised to 100% at 1 hour post mortem (A, B, C) and 96 hours post mortem (D, E).

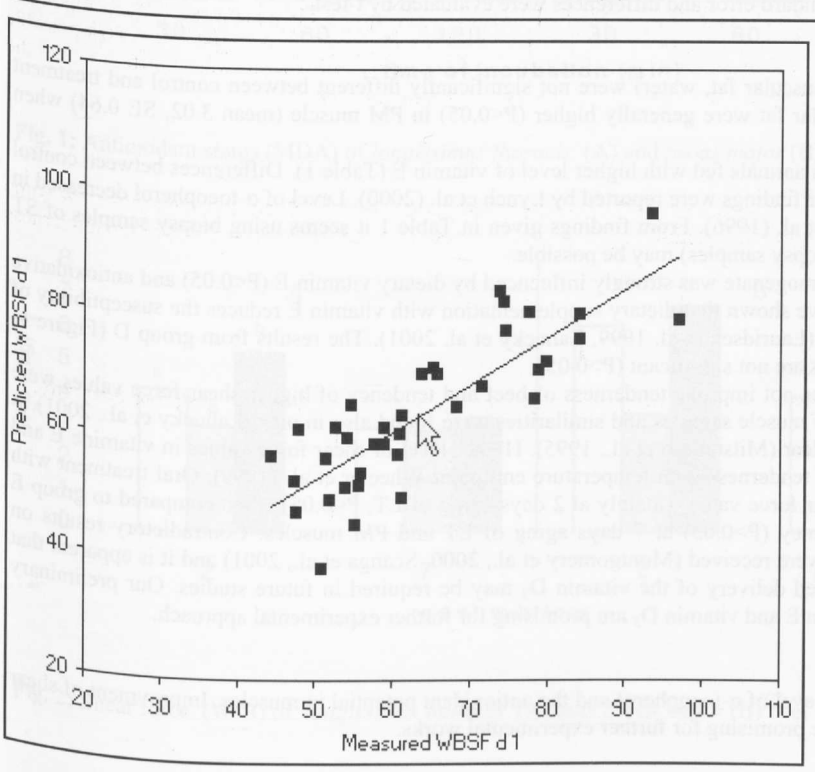


**Figure 3. Prediction of Warner-Braztler shear force (WBSF) 24 hours post mortem.** A PLS model based on the peptides profile obtained 4 hours post mortem was used. The model was validated using full cross validation resulting in the following statistics:

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|---|---|
| Animals: | 37 |
| Slope: | 0.78 |
| Offset: | 13.71 |
| **Correlation:** | **0.83** |
| RMSEP: | 7.39 |
| Bias: | -0.23 |