PREDICTION OF WATER HOLDING PROPERTIES OF PORK MEAT BY MODELLING

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SUMMARY

Several fresh meat parameters have been described as predictive for meat quality. The predictive value, however, is often limited. The purpose of this study was to improve the prediction of meat quality, i.e. the water holding capacity, by combining (modelling) fresh meat parameters and developing a mathematical model.

M. longissimus was removed from pork carcasses (24 hours p.m.) after visual selection on colour differences. Several parameters were measured, such as drip formation, water holding capacity (filter paper method), pH, electrical conductivity, redox potential, light reflection, tristimulus colour values, extracellular potassium, glucose, and glucose-6-phosphate.

Statistical evaluation of the data demonstrated correlation coëfficients varying from .39 to .88 between drip formation and the other parameters. Drip formation and water holding capacity were highly related (r= .88). Glucose content had a higher predictive value (r= .85) for drip formation than any of the other parameters tested. Prediction of water holding capacity (drip formation) could be significantly improved by a model containing glucose content, pH, tristimulus colour values, light reflection and electrical conductivity. The correlation coëfficient between this model and drip formation was .95.

This study indicates that glucose content is an interesting parameter for prediction of water holding properties of pork meat (24 hours p.m.). In addition, this prediction can be improved significantly by mathematical modelling of parameters.

Introduction

In the meat branch there is a need for giving an optimal destination to meat raw materials. Depending on its destination different quality parameters are relevant, such as water holding properties, colour, colour stability, tenderness, and fat binding properties.

Several fresh meat parameters have been described as informative for meat quality. Rigor, drip formation, water holding capacity, pH, light reflection properties, and electrical conductivity properties should be mentioned in this respect. These parameters have a predictive value for the consumers appreciation of meat or for meat product quality after processing of meat. The value of these predictions, however, is often limited. Concomitantly, application is still hardly observed in slaughter-houses and the meat processing industry.

The aim of this study was to improve the possibilities for predicting meat quality, in particular water holding properties. It was based on the assumption that the complex nature of meat requires a multiple parameter approach for quality prediction.

Materials and Methods

M. longissimus was removed from 24 carcasses (24 hours p.m.). The carcasses were selected visually on colour differences (pale, normal and dark).

Water holding properties were determined by two methods: 1. drip loss during storage of M. longissimus slices (3 cm thick) for 48 hours at 5°C by weighing slices before and after storage (Bendall and Swatland, 1988), and 2. water holding capacity with the filter paper method according to Kauffman (1986).

pH was measured at two sites of the M. longissimus using a PHM 85 meter (Radiometer) with a N6880 combined electrode (Schott). The average value was used.

For the determination of glucose and glucose-6-phosphate, meat samples were comminuted and extracted in 1.5 M perchloric acid, followed by centrifugation. KOH (10 N) was added to the extracts until pH 10 to 11. After filtration, glucose and glucose-6-phosphate were determined in the filtrates using a commercial test kit (Boehringer, test kit 761251).

For 'extracellular' potassium, meat samples (2x2x2 cm) were soaked in demineralized water for 2 min. Subsequently, the potassium content of the water was measured using a potassium selective electrode (F 2002-03, Radiometer) connected with a PHM 85 meter (Radiometer)

The redox potential was measured at two sites of the M. longissimus using a redox electrode (Pt 62, Schott) connected with PHM 85 meter (Radiometer). The average value was used.
Light (560 nm) reflection as well as absorption was measured at a depth of 2 cm and at two sites of the M. longissimus using the CTM (Colour meter for Translucent Materials) (Sensoptic).

Colour was measured with a LabScan tristimulus spectrometer (Hunter) and expressed as L*, a* and b*-values.

Electrical conductivity (at 1 kHz) was measured with a LF 191 electrode (Wertheim Technische Werke). The LF 191 electrode has been specifically developed for fresh meat measurements.

Results and Discussion

The data of nine parameters obtained from the M. longissimus samples (n=24) are given in table 1. The samples are classified by increasing drip formation. These data and those of the other parameters measured were statistically evaluated with respect to prediction of water holding properties, i.e. drip formation and water holding capacity. The correlation coëfficients (r) of this evaluation are shown in table 2.

The predictive value of different parameters is somewhat higher for water holding properties of M. longissimus than those reported in some other studies. It is likely that this must be ascribed to the selection procedure of the samples. An at random selection of samples may have resulted in somewhat lower r-values.

Drip formation and water holding capacity showed a strong relation. The most striking result concerned the relative high predictive value of glucose for water holding properties. The glucose content had a higher predictive value than any of the other parameters tested in this study. Reasonable prediction was observed for pH, tristimulus values L* and a*, and light reflection (CTM refl). Electrical conductivity had a moderate predictive value, while the other parameters showed weak relations with water holding properties.

In general, studies on predictive parameters for water holding properties of meat have been resticted to singular relations. However, the results indicate that the measurement of a single parameter does not result in a highly reliable prediction of these properties. This finds also expression in the limited application in the meat industry.

Therefore, the effect of mathematical modelling of different parameters was investigated to improve the prediction of water holding properties. This approach revealed that modelling of combinations of parameters results in an improved prediction. For instance, a maximal and significant improvement was obtained by modelling pH, L*, a*, b*, CTM (refl), electrical conductivity and glucose content. The formula of this model was:

Drip formation (%) = 35.1 - 4.98 * pH - 0.17 * L - 0.15 * a + 0.33 * b + 2.85 * CTM + 0.32 * EC + 1.77 * [Glucose]

The correlation coëfficient was .95 between this model and drip formation. With the present M. longissimus samples, the model predicted drip formation with a maximal deviation of only 1 %.

Conclusions

The results of this study show that

* the glucose content is a predictive parameter for water holding properties of porcine M. longissimus (24 hours p.m.).

* the prediction of water holding properties of porcine M. longissimus can be improved significantly by mathematical modelling of parameters.

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