SNAPSHOT

NON-INVASIVE PREDICTION OF FLAVOUR, TENDERNESS & JUICINESS FOR INIDIVIDUAL ANIMALS AT POINT OF SLAUGHTER

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Project Description

Meat quality is known to vary between individual animals and results from the interactions of a number of biochemical and biophysical processes occurring post-slaughter, which are influenced by the pre- and post-slaughter environments. A major challenge for processors managing the natural in-plant variation is identifying the unique quality attributes of each carcass at a suitable point in time in order to introduce processing interventions for improving product consistency and also capture the value of animals with exceptional eating quality.

The purpose of this project was to develop a mathematical model based on the known biochemical and biophysical changes which occur as muscle is converted to meat. We qualitatively assessed the model against measurements of key factors in a single muscle from slaughter and throughout ageing for providing a proof of concept that is feasible to use the model to predict post-mortem biochemical changes in meat.

Project Content

Preliminary models for key biochemical processes underpinning meat quality after slaughter were developed at the muscle-fibre level and subsequently refined using expert parameterisation to obtain appropriate qualitative behaviour. The refined models were used to simulate how outcomes of these biochemical processes were affected by glycogen depletion, electrical stimulation and temperature changes during the ageing process.

Overall model performance was assessed against one muscle (no electrical stimulation, 5 ^{o}C, 14 days ageing) by comparing the model outputs with empirical data for key factors including energy metabolites, calpain I and

calpastatin, as well as proxies for protein degradation and water holding capacity. Assessment of the fit has been provided by the coefficient of determination (R^2) and the standard deviation of the residuals, reported as the root mean square error (RMSE).

Project Outcome

The empirical data obtained from the chemical analysis and meat quality measures were found to be comparable with those reported for beef *M. longissimus thoracis et lumborum* (striploin) produced under similar conditions i.e. no electrical input and similar ageing regime.

Qualitatively, the model compared well with the data obtained. The relationships between the predicted and measured variables were found to have R^2 of up to 0.92, indicating that the model qualitatively described the dynamic change in most of the metabolites. However, the R^2 values for ADP, IMP and AMP were all less than 0.5 indicating deficiency in this area.

Benefit for Industry

Currently the meat industry is limited to measuring meat quality in terms of ultimate pH, meat and fat colour and degree of marbling. This project aimed to provide a method for predicting a broader range of meat quality attributes as well as ultimate pH based on the measurement of key biochemical parameters soon after slaughter.

The advantage of using a mathematical model to predict meat quality attributes is that easily measured parameters such as pH, temperature or near infrared spectra could provide the basis for the model variables, making the model more readily available to commercial plants due to the lower operating cost and technical difficulty compared with other measurement systems.

The model developed here is preliminary and will require more experimental work to assess the behaviour of the model under a range of scenarios and identify where it can be improved and extended if necessary.

Combining the quantitative model with a non-invasive measurement technique at slaughter will benefit the industry in several ways:

- Early post-slaughter prediction of meat quality for individual animals would provide the basis for decision making in-plant required to manage and reduce the variation observed.

- Precise prediction of time course of ageing would allow minimum times to be specified for the desired meat quality attributes to be obtained and identify the period required for optimal eating quality. In addition to providing a better consumer experience, this tool could reduce chiller and storage time, with plant-specific cost savings and an increase throughput for the same storage capacity.

- Rapid prediction of meat quality on a per carcass basis would allow identification of premium carcasses, divergent processing based on carcass value and the potential to differentiate pricing based on a range of carcass and biochemical measures; additionally, providing feedback to producers to adopt on-farm procedures that improve meat quality.

- Precise knowledge of meat quality outcomes would provide the basis for pricing strategies that generate a premium in return for quality guarantees.

USEFUL RESOURCES

- Information on AgResearch and its Food Research can be found here: https://www.agresearch.co.nz/our-science/food-and-bio-based-products/
- Information on working with AgResearch can be found here: https://www.agresearch.co.nz/doing-business/working-for-you/