Snapshot Report

AMPC
AUSTRALIAN MEAT PROCESSOR CORPORATION

Bovine IMF Measurement Production Prototype

Full Project Title

Project Code
2021-1128

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Date Submitted
25/06/21

Project Description

Nuclear Magnetic Resonance (NMR) can measure IntraMuscular Fat (IMF) of meat when samples are cut from the carcase and measured in a benchtop system. In this project we investigate how this technology may be extended to measurements of beef carcases in an abattoir. In addition to the NMR performance in relation to IMF prediction, we investigate the practical implementation of this technology in an abattoir. Consideration is made on placement to create the greatest benefit such as along the chain to measure hot carcases, in the chiller to grade carcases, or at the end of the boning room to grade high value primals. We evaluate the potential of NMR by measuring beef short loins with a prototype NMR technology designed for ovine carcases.

Project Content

This project was commissioned to evaluate the potential for an NMR system that could non-invasively measure beef IMF on an uncut carcase. The project included a visit to an abattoir and collecting NMR measurements on 20 short loin samples with a range of IMF and Meat Standards Australia marbling scores. In this project we define the sample (location of measurement), design a system to accommodate and align the NMR to the sample, suggest a location in an abattoir for system incorporation, and evaluate the ability of NMR to predict IMF in beef samples.

Figure 1. A beef short loin on the ovine carcase sensor.

Project Outcome

Measurement design in an abattoir

The ultimate goal is to evaluate a whole carcase, however, we can only measure a tiny portion similar to how a grading cut surface is used to evaluate the whole beef carcase. The ideal measurement site would be the anterior portion of the short loin; posterior of spinalis muscle terminus, *i.e.,* close to the grading surface. The best position on the slaughter floor to measure hot carcases was determined to be after the carcase is split into sides and before it is weighed and tagged. We feel this location adds the greatest value because it provides early insight into IMF and marbling to assist with sorting into the chiller. The system could also be setup to measure high value primals at the end of the boning floor just before boxing and labelling with a grade.

Figure 2. The optimum measurement location is above the grading cut, rear of the spinalus muscle and adjacent to the spine.

Key feedback from processors was a concern about keeping up with the chain. Each measurement in this study took about three minutes due to the manual aspect of positioning the sample, optimizing the sensor, and signal averaging. These aspects can be automated and signal averaging can be reduced so that the total measurement is 5-10 seconds. That would be 6-12 sides or carcases a minute (up to 700/hr) depending on whether both sides are measured. These preliminary measurements and design concepts suggest that the instrument could keep up with the chain. While we have presented several concepts related to a production prototype design, we will work closely with industry partners to further develop them to meet abattoir compatibility and requirements.

Correlations of NMR with IMF and marbling

The correlation between NMR and fat content are shown in Table 1. We observed a correlation of R^2=0.89 between NMR and IMF for chilled samples and a correlation of R^2=0.86 for the hot samples (proxy for hot carcase). The NMR correlated with MSA marbling at a value of R^2=0.91 chilled and 0.86 hot. Due the measurement objectivity, NMR was able to identify one outlying marbling score shown as the orange point in Figure 3. While the marble score could be accurate, it was not a good indicator of the IMF. This shows NMR's value in grading and sorting.

	Correlation (R^2)
Beef chilled	
IMF	**0.89**
MSA marbling	**0.91**
Beef warmed	
MSA marbling score	**0.86**
IMF	**0.86**

Table 1: Correlation (R^2) of NMR data with IMF and MSA marbling score.

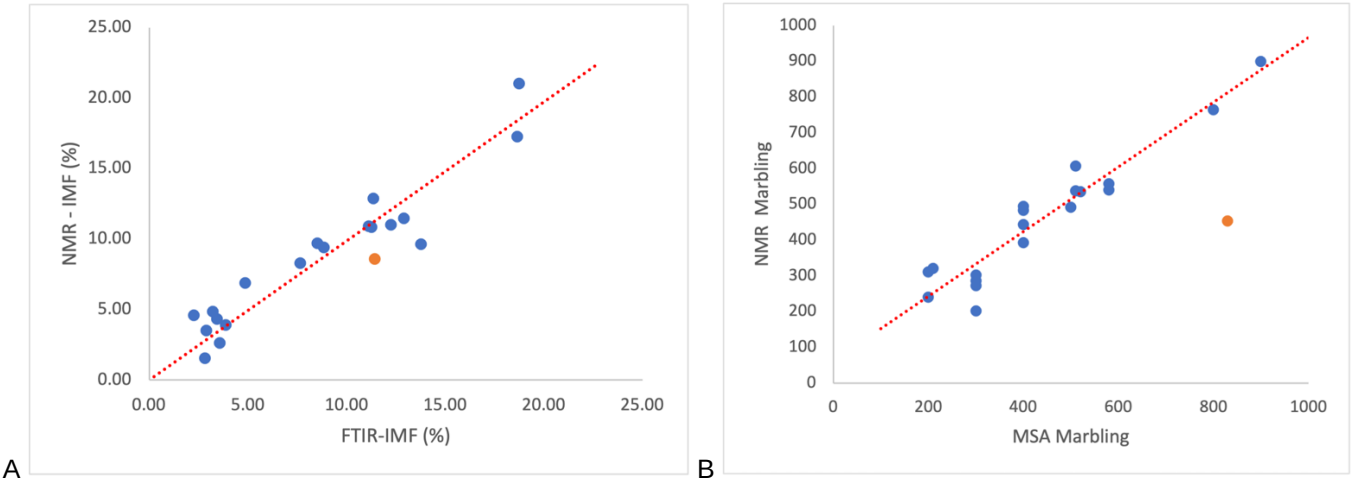

Figure 3. NMR was able to predict (A) IMF and (B) Marbling. The outlier data from body 566 is shown as the orange point.

Benefit for Industry

An investigation was commission by Meat and Livestock Australia in 2008 to provide a cost/benefit analysis of inline NMR measurement for the lamb industry through consultation with producers. They found five categories of benefits for the processing industry.

- Classification tool
- Upgrade tool
- Filtering tool
- Feedback tool
- Marketing tool

While categories arose from a lamb industry study, similar areas of benefit can be expected for beef. A key benefit of this technology would be IMF information prior to entering the chiller, which would tie into classification, upgrading, and filtering pre-rigor.