final report

Project Code: P.PSH.0512

Prepared by: FIX-ALL Services Ltd

Date published: July 2011

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

G2 Tenderometer benchmarking & adoption

This is an MLA Donor Company funded project.

Meat & Livestock Australia and the MLA Donor Company acknowledge the matching funds provided by the Australian Government to support the research and development detailed in this publication.

1 Background

Background

There have been many attempts to develop meat tenderness measurement devices over the last 30 years. However, despite the 20 or so devices that are reported in the literature, the most commonly used devices are still the G1 Tenderometer and the Warner-Bratzler.

The Warner Bratzler was developed in the 60's and the basic design measures the maximum force required to cut through a core of meat. Despite the widespread use of this system, it is well recognised that the preparation of the meat cores is highly operator dependent and can readily result in a high degree of variation between samples. The slicing action itself is also time-consuming, and depending upon the recording devices attached to the basic shearing apparatus, some variation can also result. Although the Warner-Bratzler system describes the cutting apparatus, the main mechanical displacement system that operates the blade are typically linear displacement motors which are very expensive therefore make it a heavy & expensive piece of technical equipment (Lloyd instrument cost is over $100k with around $35,000 to replace the load cell only).

In the early 1970's MIRINZ (Meat Industry Research Institute of New Zealand) developed the first or Generation One (G1). This device was developed in an effort to provide a quicker, cheaper and more reliable tool to measure cooked meat tenderness - one that could be used in both a research and a commercial environment.

The device was based upon measuring the force required to shear through a 1 cm x 1 cm slice of meat. The shearing device was a triangular blade and was designed to simulate a human tooth which sliced downwards through a meat sample that was contained in a 1 cm wide tray (see Figure 1 below). The device was based on pneumatics which required connection to a supply of compressed air, but overcame the significant cost associated with the linear displacement motors of the Warner-Bratzler devices. Based on very promising trials, the G1 Tenderometer was adopted as the industry standard measurement tool for meat tenderness.

While the G1 Tenderometer has clearly stood the test of time and continues to be used in both research laboratories and meat processing plants throughout New Zealand and Europe, the need to have a unit that is more portable and flexible has become apparent.

The G1 Tenderometer is bulky and relatively heavy (12kg); and has limited portability due to the air pressure and power requirements.

Furthermore, measurement values displayed by an LED allow for potential error due to incorrect value recording due to manual recording. Each machine, despite standardised manufacturing processes, generates different internal resistances due largely to the unavoidable friction forces that are inherent in pneumatic systems and, therefore, requires at least annual calibration. Furthermore, these effects result in instrument to instrument variability which can be particularly problematic for meat processors that have several instruments in use to audit against their tenderness specification. The pressure required to shear a meat sample is displayed in Kilo Pascals and these then have to be converted to Kilograms shear force (kgf). The conversion formula is generated during the calibration procedure. While this conversion is easily generated using a simple Excel based macro, the final shear force values are not given at the time of sample measurement.

1 G2 Tenderometer development to date

To address all of these issues, a new Tenderometer, known as the G2, has been constructed as part of the current Meat Quality, Science and Technology programme, funded jointly by Meat & Wool New Zealand and Meat & Livestock Australia.

The key points of the design of this new unit are the miniaturisation, water proofing and mobility of the unit, improved sample loading and automated sample shearing and data downloading.

The device is based on an electric motor which pushes the meat against a fixed load cell. The unit does not therefore require compressed air, just a standard power socket to plug into or batteries.

The samples are placed in a line on a tray that presents the samples to the shearing head. The new sample loading and switch sequence allows automatic cycling of the unit; in essence, this means that the 10 sample bites can be loaded into the presentation tray and the unit will then cycle automatically through the shearing procedures, testing and recording the values from each sample automatically without any further operator intervention.

In laboratory conditions, the G1 and G2 Tenderometers appear to correlate closely (r^2 = 0.89-0.94) to standard shear force measurements (i.e. Warner-Bratzler method), and therefore appear reliable as an objective tenderness measure.

Note that the absolute values of KgF for the standard method are different to the results (at a similar tenderness rating) to either the G1 or G2 Tenderometer. Hence, this may be an immediate obstacle for adoption amongst certain user groups in Australia, such as science groups, which have mostly relied on the expensive testing methods in the past. However, after saying this, all science groups in Australia are involved and providing various level of scientific support in current MLA strategic EQ & MQST research, and are in principle supportive of using the G2 Tenderometer for various applications. The likelihood of adoption of G2 amongst processors and science groups is rated highly because of the support from the research groups and presence they have in those plants also likely to adopt MQST technologies & capability.

2 G2 Tenderometer status

In 2007, Carne Technologies Limited (Carnetech) was chosen as the commercialiser of the G2 Tenderometer, with Fix-All Services as the sub-contracted manufacturer. These two organisations have developed the original prototype G2 Tenderometer to a pre-commercial version. Carnetech has also carried out some laboratory trials to calibrate the G2 Tenderometer against previous technologies.

This process has proved to be much more difficult and lengthy than anticipated, with the pre-commercial unit only now ready for industry trials.

Sales of 81 units were anticipated by end 2009, but no sales have been achieved so far. Furthermore, manufacturing costs have risen from the original NZD 6000 per unit (including Carnetech margin) to NZD 6800 (excluding Carnetech margin).

3 Project description & outcomes

Under this project MLA and MWNZ co-funded the manufacture of ten units by Fix-All Services (this is the minimum production run required so as to achieve a reasonable manufacturing price point and trial in a variety of Australian/New Zealand processor and research locations). These were to be supplied to various Australian and New Zealand processors or research locations. In New Zealand, sites primarily were focussed on hot boning trials and these are likely to include Alliance Group, Silver Fern, ANZCO and AFFCO or AgResearch.

In Australia, the several processors/researchers had already approached MLA for objective measurement technologies and hence were likely to trial the G2 Tenderometer.

Each processor was to have the option of purchasing the G2 Tenderometer during or at completion of the project if they wished to continue using the G2 Tenderometer. This was to be strongly encouraged so as to validate the true value proposition to each processor.

Carnetech (New Zealand) and a NSWDPI (Australia) were to monitor each trial, provide technical support (especially where the G2 Tenderometer is being calibrated against existing technologies) and report to MLA and MWNZ as regards the final outcomes of the project.

In Zealand, several processors trialled the G2, but there was only limited interest from Australian processors in the technology. Only one processor, ACC, has taken delivery of a G2 for commercial use.

As this was the first pre-production run for use by industry, some usability and design issues were identified. While these could easily be addressed in a subsequent production model, it is unlikely that the demand for the technology will make this worthwhile.
Further information on the G2 Tenderometer is available at
http://www.redmeatinnovation.com.au/innovation-areas/eating-quality/products/g2-tenderometer

The following reports are available on the usage and trial assessment of the G2.

- G2 Tenderometer benchmarking adoption