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Technical Report

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Report Title: Commercialise two technologies for grading eating quality in beef carcasses and two technologies for grading eating quality in lamb carcasses

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Abstract

This report summarises the experimental work and results evaluation and discusses commercialisation of technologies for grading eating quality in beef and lamb. Five (5) cut surface grading technologies and two (2) grading technologies are in the commercialisation phase in beef and lamb respectively. Importantly, the work conducted by in this section of ALMTech II has assisted in achieving the key deliverable to commercialisation at least of two technologies for grading eating quality in beef and lamb carcasses. These technologies are now accredited for use within industry and available for purchase and integration within individual supply chains.

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Executive Summary

This report summarises the experimental evaluation and commercialisation of technologies for grading eating quality in beef and lamb. Five (5) cut surface grading technologies and two (2) grading technologies in the commercialisation phase in beef and lamb respectively. Importantly, the work conducted by in this section of ALMTech II has assisted in achieving the key deliverable to commercialise at least two technologies for grading eating quality in beef and lamb carcasses. These technologies are now accredited for use within industry and available for purchase and integration within individual supply chains.

For further detail the appendix contains the following reports summarise the key devices investigated in Sub-Program 2.1 Table 1 describes the various stages of AUS-MEAT accreditation of all devices.

- Report on the calibration and validation of the Frontmatec commercial camera in beef
- Report on the precision and accuracy of the Frontmatec grading camera against AUS-MEAT camera accreditation requirements
- Report on AUS-MEAT accreditation performance of the MasterBeef system
- Report on the accreditation results for the VIAScan CAS cut-surface beef commercial camera
- Report on the accreditation of the SOMA NIR device to predict chemical IMF% in lamb
- Report on the validation performance of the MEQ probe to predict IMF% in MLA Resource flock lambs
- Report on the desktop calibration, repeatability, and validation of a hyperspectral camera (prior to LEAP installation)
- Report on impact of environmental factors (i.e., bone smear, temperature) on prediction of lamb cut surface traits by a hyperspectral camera (prior to LEAP installation)
- Report on the integration of a hyperspectral camera with Scott's LEAP system and MSA Mk II lamb grading model

In parallel to the experimental work, Program 2 has been fundamental in driving commercialisation at an operational level. This was achieved through on-going supply chain engagement, developing AUS-MEAT accreditation standards and industry roll-out and supporting the commercial integration of devices within companies.

1.1 Frontmatec Q-FOM grading camera

The Q-FOM is a non-contact, rechargeable device specifically designed for ribeye grading according to AUS-MEAT and MSA grading standards, either in the chiller or at a grading station. The Q-FOM is capable of grading in real-time MSA and AUS-MEAT marble score, AUS-MEAT eye muscle (EMA), AUS-MEAT meat colour, AUS-MEAT fat colour, MSA subcutaneous rib fat and chemical intramuscular fat (IMF%) and loin surface temperature. This work was conducted as part of a collaborative project between Australian Country Choice (ACC), Frontmatec and ALMTech. Over 4500 carcasses were graded as part of the Q-FOM calibration and accreditation across 8 experiments between May 2021 and November 2022. At the time of reporting, the Q-FOM had achieved or was eligible for: Full AUS-MEAT approval for MSA marbling, AUS-MEAT marbling 0-6 and AUS-MEAT fat colour 0-6 and

AUS-MEAT eye muscle area. The Q-FOM also received conditional AUS-MEAT approval high marbling (7-9). Plant integration and data management, a key milestone for the project was advanced and ready for deployment. During the project timeframe, Frontmatec signed with Columbit, an Australian based distributor responsible for sales and technical support. This will facilitate the adoption of the Q-FOM camera within beef supply chains.

1.2 MasterBeef grading camera

The MasterBeef is a beef cut surface grading camera trained to predict a range of traits including MSA Marbling, AUS-MEAT marble, Eye Muscle Area, Rib Fat, Fat Colour and Meat Colour. It utilises the camera from a Samsung A70X phone which is mounted on to a 3d printed plastic shroud. The software has been developed for android and can be downloaded from Google Play Store. The device throughout training and validation has imaged a total of 1762 beef carcasses across 3 formal AUS-MEAT accreditation trials. Following these trials, MasterBeef received full AUS-MEAT approval for MSA marbling.

1.3 VIAScan CAS system

The VIAScan CAS is a beef cut surface grading camera trained to predict a range of traits including MSA Marbling, AUS-MEAT marble, Eye Muscle Area, Rib Fat and Meat Colour. It is a purpose-built device utilising an RGB camera mounted behind a UV filter surrounded by a stainless-steel shroud. The device throughout training and validation has imaged a total of 1451 beef carcasses across 3 formal AUS-MEAT accreditation trials. The final report consolidates the latest VIAScan CAS beef grading camera accreditation process held in November 2022, including the analysis and results of the device, according to AMILSC approved minimum requirements of repeatability and accuracy standards for cut surface camera technologies. The VIAScan CAS met the AMILSC standard for accuracy to achieve preliminary MSA marbling accreditation, however repeatability of the device will need to be proven.

1.4 SOMA NIR device

The SOMA S-7090 NIR is a battery powered portable cut surface device that measures IMF% on chilled sheepmeat at the 12th/13th rib. It uses non-destructive near-infrared spectroscopy using the wavelength range 885 – 1015nm from the surface of muscle tissue to provide IMF% prediction. Following extensive calibration and validation work (reported in sub-Program 2.2), the SOMA device underwent an accreditation trial utilising 431 lamb carcasses from two lamb processing facilities Fletchers International Exports, Dubbo, NSW and Thomas Foods International, Tamworth, NSW. The performance of the SOMA device was compared against AMILSC approved guidelines was accredited for AUS-MEAT for predicting chemical IMF% between 3.5 and 8.0%.

The SOMA has been used by Meat Standards Australia (MSA) and brands to benchmark the distribution of chemical IMF% and MSA eating quality score of commercial lambs. This work is critical to the adoption of MSA individual carcass grading of lamb.

1.5 MEQ probe in lamb

The MEQ probe is a handheld device accredited to measure Intramuscular fat (IMF%) percentage in hot sheep carcasses. The probe utilises a trigger equipped with three light

emitting probes that is inserted into the *M. longissimus lumborum* of a hot sheep carcass. The device is mounted on site within the chain of commercial abattoirs utilising 3 phase power. The probe is inserted once into the *M. longissimus lumborum* and analyses measured light reflectance returned to the probes as they are removed from the muscle. This report has been prepared by ALMTech on behalf of MEQ for validation of the MEQ Probe. The commercial data and samples were collected across September, November, and December 2022. The trial plan includes the MEQ Probe predictions of IMF% in comparison to the gold standard lab NIR IMF% predictions. The data is analysed using the purpose-built Sheep Meat IMF accreditation shiny app, the results are presented according to AMILSC approved guidelines for experiments to achieve accreditation of technologies for predicting chemical IMF% in sheep meat (Version 3.0). Within normal commercial operation of the MEQ probe, the device has demonstrated sufficient accuracy to pass the AMILSC chemical IMF% accuracy standards between the IMF ranges of 1.4 to 6.5%.

1.6 Hyperspectral LEAP camera system in lamb

This was a challenging project with disruptions due to COVID-19 and supply chain delays. The project involved collaboration between JBS Brooklyn, Scott Automation, AgResearch (New Zealand) and ALMTech. The hyperspectral camera was selected such that it had high quality spectral resolution especially at infra-red wavelengths. These types of cameras use a custom mirror system to move the field of view across the loin eye surface. The hyperspectral camera system has been successfully installed on the Scott LEAP system and is able to generate IMF% values on racks which are linked to carcass identification and lean meat yield values. Further work is still required to improve IMF% prediction and validation prior to AUS-MEAT accreditation and full commercialisation of this device.

2 Conclusion

Overall, Program 2 has successfully met the scientific outcomes of the ALMTech II project through the commercialisation of two devices in beef and two devices in lamb. Further work will be required post-ALMTech to support commercialisation of objective grading technologies in the future. This will require coordinated strategic effort and governance by R&D organisations (MLA and AMPC), Meat Standards Australia, AUS-MEAT, technology providers and processors. An on-going collaborative approach between all stakeholders is required to ensure the adoption of technologies, new grading systems and more effective feedback and pricing signals to producers. It will also ensure new opportunities are embraced as technology and understanding of factors affecting eating quality continue to evolve.

Table 1 AUS-MEAT accreditation status (conditional and full approval) of beef and lamb devices

AUS-MEAT accreditation status of cut surface traits									
Species	Device	MSA marbling	AUS-MEAT marbling 0-6	AUS-MEAT marbling 7-9	AUS-MEAT Eye Muscle Area (EMA)	AUS-MEAT Meat colour	AUS-MEAT Fat colour	MSA Sub-cutaneous rib fat	Chemical IMF%
Beef	Frontmatec Q-FOM beef camera	✓	✓	✓	✓		✓		
	MasterBeef camera	✓							
	MEQ probe	✓		✓					
	MEQ grading camera	✓	✓	✓			✓		
	Meat Imaging Japan (MIJ) camera			✓					
Lamb	MEQ probe								✓
	SOMA NIR								✓

*note: information was accurate at the time of reporting. Credit AUS-MEAT.