Australian Government
Department of Agriculture, Fisheries and Forestry

Technical Report

Program and KPI: Sub-program 4.2 KPI 3.30

Report Title: Compilation of final reports for data flow to industry genetic evaluation systems

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Executive Summary

The program has completed the genetic validation of 7 new genetic tools for the sheep industry;

1. DEXA was validated as an accurate genetic prediction of CTlean and thus LMY breeding values. This provides the evidence for Sheep Genetics to commence using these data in routine genetic evaluation.
2. MEQ was validated as an accurate genetic prediction of IMF and thus IMF breeding values. This provides the evidence for Sheep Genetics to commence using these data in routine genetic evaluation.
3. A preliminary validation was conduction of SOMA, which indicates that it will also be an accurate genetic prediction of IMF. More SOMA data now needs to be collected on resource flock animals to complete this work.
4. Preliminary validation of genomic flock benchmarking in Terminal sheep was conducted and demonstrated accurate results. This provided sufficient evidence to support ongoing development of this product.
5. Preliminary validation of genomic flock benchmarking in Maternal sheep was also conducted and demonstrated accurate results. This provided sufficient evidence to support ongoing development of this product.
6. Analysis of eye muscle dimension data suggests the need for a new definition of these traits, which is likely to lead to new eye muscle width or area traits for sheep. More eye muscle dimension data now needs to be collected on resource flock animals to complete this work.
7. A new model for improved analysis of the shear force trait was also defined and validated for use by Sheep Genetics.

Program 4 also examined the value of using carcase data from industry ram breeding (seedstock) flocks to build upon an industry sheep reference population in Australia. This work concluded that seedstock data can be used if data collection is accurate and consistent with industry standards and this enables new models to work with industry flocks to provide genetic resource flock data.

During the life of the project, insufficient data was available from new devices on genetic resource animals in beef. Thus, no significant analysis or development work was able to be conducted. Nevertheless, ALMTech II has also continued to work with BREEDPLAN to evolve the eating quality traits away from marble score toward IMF, which is likely to be captured from the new beef rib-eye cameras. In a similar vein, work has commenced to validate the use of DEXA in beef and begin the development of a LMY breeding value for beef.

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1 Subprogram 4.2 Data flow to industry genetic evaluation systems

1.1 Genetic evaluation in Lamb

The aim of the program was to examine the value for various measurement technologies to aid the selection by producers to improve lean meat yield and eating quality.

Program 4 performed the genetic analysis for novel intra muscular fat phenotypes in lamb, collected as described in KPI's 3.30.3 using MEQ and SOMA NIR probes. The first data analysed (1380 records from MEQ and 1320 for SOMA NIR) showed that the new traits are heritable and that there is a strong genetic association between MEQ and SOMA NIR measured intramuscular fat, and chemical IMF in lamb. These devices are likely to provide a faster and easier way to objectively assess IMF content, and are suitable for use to improve eating quality in sheep breeding programs. When more data becomes available results will be reassessed to conclude that MEQ and SOMA NIR recorded intramuscular fat is equivalent to chemical IMF, based on variance estimates, heritability and genetic correlations with the other traits used in the main Sheep Genetics genetic evaluation.

The program has also successfully completed a range of analyses to understand the genetic association between eye muscle dimensions (depth and width) in lamb. Eye muscle dimensions are important because they can facilitate selection for lean meat yield which in turn is an important driver of profit for producers, processors and retailers of sheep meat. These dimensions could also relate to eye muscle shape which could have retail value. To determine the genetic relationship between eye muscle dimensions in sheep, three different data sets were used, including ultrasound, calliper and computer tomography records. Data analyses showed that ultrasound eye muscle depth should continue to be used as a selection trait to improve eye muscle depth. Because of weaker correlations between eye muscle width and depth, more research is required to determine if current selection practices are changing the dimensions of the eye muscle within the carcase and increase the need for an eye muscle width or area breeding value.

Records of lamb fat, lean meat and bone collected with Dual-Energy X-ray Absorptiometry (DEXA) were analysed to determine the genetic variation in DEXA measured lean. The analysis also looked at the suitability of using DEXA lean as part of the National Genetic Evaluation alongside or in conjunction with current lean meat yield records. The Algorithms behind the conversion of DEXA images to measures of lean, bone and fat have been updated since the preliminary research in 2017. A total of 2,989 DEXA records from genetically informed animals were available and the analysis showed moderate heritability for DEXA lean and strong favourable genetic correlation between DEXA and Computer Tomography (CT) lean. These results are promising for the utilisation of DEXA data within Sheep Genetics national evaluation.

Program 4 also examined the value of using carcase data from industry ram breeding (seedstock) flocks to build upon an industry sheep reference population in Australia. Data from 1,981 lambs managed in 16 commercial ram breeder flocks were collected between 2017 and 2020 for carcass and meat quality measurements: hot carcase weight, tissue depth at the GR site, eye muscle depth, fat at the C site, intramuscular fat and shear force. Seedstock data were cross-validated with and

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without reference data from the MLA Resource flock. Analysis showed that seedstock data did not bias the estimation of breeding values when used in combination with the reference population and can be used to complement managed progeny test sites to create an industry reference population. The effectiveness of this data depends on the trait measured (completeness of data and good representation of the flock's diversity) and the influence of fixed effects recorded on the flock. Therefore, seedstock data can be used if data collection is accurate and consistent with industry standards.

Within Program 4 the model for the analysis of shear force in lamb was revised. This analysis used shear force data from 32,913 lambs collected between 2007 and 2020. Available data could not define a clear temperature threshold for cold shortening. The relationship between shear force and temperature at pH6 appears to be linear with no cut-off point and there is a lot of variation in shear force and temperature at pH6 between different sires and contemporary groups. Variance components estimation and progeny performance predictability was improved through a combination of filtering out carcases with extreme shear force values and transforming the remaining data. The genetic correlations obtained with this approach were more consistent for animals of different breeds while in agreement with the older analysis.

The Flock Profile test provides a genomic benchmarking tool for commercial Merino flocks and is routinely use in the Merino industry. A preliminary validation of genomic flock benchmarking in Terminal and Maternal sheep was also conducted within Program 4.2 and this demonstrated accurate results. This provided sufficient evidence to support ongoing development of these new products.

1.1.1 KPI 3.30.1 Continue to report on genetically defined beef, lamb and pork animal resources that can be utilised for testing and calibration of measurement technologies, underpinning early development of genetically defined datasets linked to these technologies

1.1.2 KPI 3.30.2 Report on further analysis of eye muscle dimension data sourced from direct carcase measures and those obtained from CT images

1.1.3 KPI 3.30.3 Report on the analysis of SOMA NIR data predicting IMF, and the potential to manipulate IMF traits genetically

1.1.4 KPI 3.30.4 Report on the results of the updated genetic evaluation of DEXA and the genetic correlations with CT measures of lean meat yield

1.1.5 KPI 3.30.5 Review the MLA Resource flock overlay projects in regard to the quality of carcase data and the value of the animals as part of the reference population

1.1.6 KPI 3.30.6 Report on the final implementation of revised shear force model in Sheep Genetic evaluations

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1.2 Genetic evaluation in Beef

Analysis was also conducted in data from the MIJ camera using on Angus beef carcases which showed that the current data used was not sufficient to prove that MIJ cameras are able to predict intramuscular fat in lower marbled carcasses. Therefore, implementation of MIJ camera traits for the genetic evaluation of the breed captured in the analysis was not recommended. More records would be required both with Angus and across breeds to assess MIJ traits better.

During the life of the project, insufficient data became available from any other new devices on genetic resource animals in beef. Thus, no significant analysis or development work was able to be conducted. Nevertheless, ALMTech II has also continued to work with BREEDPLAN to evolve the eating quality traits away from marble score toward IMF, which is likely to be captured from the new beef rib-eye cameras. In a similar vein, work has commenced to validate the use of DEXA in beef and begin the development of a LMY breeding value for beef.

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