PREDICTION OF CARCASE INTRAMUSCULAR FAT AND MARBLING USING LIVE-ANIMAL ULTRASOUND IN AUSTRALIAN ANGUS

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I. INTRODUCTION

A common objective for Angus beef producers is to improve the carcase quality of animals used in their breeding program. Through genetics, any improvement made in the breeding herd will flow through to progeny entering the beef supply chain and ultimately to the consumer. Traditionally, direct carcase quality traits like intramuscular fat (IMF) and marbling score have proved expensive and difficult, if not impossible, to measure on selection candidates (e.g. bulls and breeding females). Due to this limitation, breeders typically use correlated ultrasound scan measurements of the live animal to increase selection accuracy of animals in their breeding program during the selection stage. The most common ultrasound scanning technology used to predict carcase IMF in Australian Angus herds is the Esaote Aquila system produced by Pie Medical (PIE). This technology facilitates crush-side and real-time image capture, interpretation and analysis using inbuilt software and algorithms. An alternative approach for the prediction of carcase IMF is the Central Ultrasound Processing (CUP) system, Ames, Iowa. The purpose of this study was to estimate phenotypic and genetic parameters for two live-animal ultrasound systems (PIE and CUP) and to determine their relationship with carcase IMF and marbling scores.

II. MATERIALS AND METHODS

All phenotypic data, associated fixed effects and pedigree data used in this study were generated from the Angus Sire Benchmarking Program, also known as the Angus Beef Information Nucleus (BIN), described by Banks [1]. The animals in the study (n=2971) were progeny of registered Angus sires (n=126) from 5 different co-operator herds located in New South Wales and Victoria, Australia. The steer progeny (n=1508) were ultrasound scanned following 95 days on feed at an average age of 614 days (SD 78.4) and killed at an average age of 795 days (SD 70.0) following a feeding period of 270 days. The steer carcases were graded (MSA and AUS-MEAT) and meat samples collected for laboratory assayed IMF. The heifer progeny (N=1463) were ultrasound scanned on-farm at an average age of 521 days (SD 82.3). ASReml software [2] was used to fit the animal model to each trait to estimate parameters based on univariate and bivariate mixed model analysis using three generations of pedigree. Fixed effects fitted in all models included the contemporary group and dam age. Age at measurement was fitted for ultrasound scan traits, while carcase weight was fitted for carcase traits. The contemporary group included herd, year of birth, sex, birth type (twin v single), breeder-defined management group, observation date (ultrasound scan or kill date) and management group history [3]. Heritabilities, as well as phenotypic and genetic correlations were calculated from the resulting variance components.

III. RESULTS AND DISCUSSION

The characteristics of the traits included in this study are summarised in Table 1.

Table 1. Number of records and the descriptive statistics for Carcase Weight, IMF and Marbling Score.

Trait[1]	*No.*	*Mean*	*SD*	*Min*	*Max*
PIE_IMF[2]	*2971*	*6.32*	*1.59*	*0.50*	*8.30*
CUP_IMF[2]	*2773*	*5.47*	*1.75*	*0.96*	*11.92*
CWT[3]	*1462*	*460.21*	*37.44*	*334.9*	*568.6*
CIMF[3]	*1475*	*10.05*	*3.28*	*3.20*	*25.1*
AMBL[3]	*1473*	*2.67*	*1.24*	*0*	*8*
MMBL[3]	*1474*	*514.40*	*120.21*	*160*	*1030*

[1] PIE_IMF: Ultrasound Scan IMF using PIE (%); CUP_IMF: Ultrasound scan IMF using CUP (%); CWT: Hot Standard Carcase Weight (kg); CIMF: Carcase Intramuscular Fat by Near Infrared Spectrophotometry; AMBL: AUS-MEAT Marbling Score; MMBL: MSA Marbling Score. [2] Steer and Heifer. [3] Steer Only.

Table 2. Heritabilities, genetic correlations and phenotypic correlations for IMF and carcase marbling traits (standard error in parenthesis).

Trait[1]	PIE_IMF	CUP_IMF	CIMF	AMBL	MMBL
PIE_IMF	**0.35 (0.06)**	0.90 (0.04)	0.74 (0.08)	0.69 (0.10)	0.70 (0.09)
CUP_IMF	0.45 (0.02)	**0.58 (0.07)**	0.70 (0.07)	0.67 (0.09)	0.72 (0.08)
CIMF	0.42 (0.03)	0.42 (0.02)	**0.62 (0.09)**	0.97 (0.04)	0.96 (0.03)
AMBL	0.36 (0.03)	0.32 (0.03)	0.56 (0.02)	**0.42 (0.09)**	0.99 (0.01)
MMBL	0.38 (0.03)	0.36 (0.02)	0.62 (0.02)	0.94 (0.01)	**0.46 (0.09)**

[1] Heritabilities on diagonal, genetic correlations above diagonal, phenotypic correlation below diagonal

Heritabilities were moderate to high for all traits. The heritability for CUP_IMF was significantly higher than PIE_IMF at 0.58 and 0.35, respectively, displaying similar standard errors (0.06, 0.07). The genetic and phenotypic correlations of PIE_IMF and CUP_IMF with CIMF, AMBL and MMBL were similar in sign, magnitude and direction as shown in Table 2. Both PIE_IMF and CUP_IMF have a moderate to strong positive genetic correlation to CIMF (0.74, 0.70), AMBL (0.69, 0.67) and MMBL (0.70, 0.72). The genetic correlations were higher than those observed Borner *et al*. [4]. Phenotypic correlations between the scan and carcase traits were moderate and positive, but lower than those observed by Herring *et al*. [4], particularly for the CUP system. In our study, the interval between ultrasound scan and carcase data was on average 181 days, while in the Herring *et al*. [4] study the interval ranged from 8 to 14 days.

IV. CONCLUSION

This study revealed both CUP and PIE ultrasound are useful early predictors of final carcase IMF and marbling, particularly on the genetic level, with genetic correlations of 0.67 to 0.74. The study also showed a significantly higher heritability for CUP IMF (0.58) compared to PIE IMF (0.35). This indicates the CUP technology is more suitable for genetic evaluation and early selection of Angus breeding animals for the meat quality traits of carcase IMF and marbling score.

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