PE9.04 The CRC for sheep industry innovation – measurement of new and novel meat traits 13.00

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***Abstract*—The Information Nucleus flock (INF) is the central focus of the CRC for Sheep Industry Innovation. The INF is made up of 8 sheep flocks across Australia that are genetically linked by the use of common sires. An objective of the INF is to measure a range of biological and production parameters and to produce heritabilities and genetic correlations for a range of new traits. Approximately 100 sires are mated annually by AI to 5000 ewes across the sites. Sires from various breeds are joined to Merino and crossbred ewes. Each year 2000 progeny are being evaluated for a wide range of meat production and consumer-relevant traits. The Sheep CRC's Next Generation Meat Quality program is undertaking the slaughter, sampling and testing of carcases and meat for a range of traits. Some of these traits are new and novel, such as the content of iron, zinc and omega-3 fatty acids and their measurement is designed to ensure lamb maintains its marketing edge as a healthy, nutritious meat — so it stays in front of other meats. This paper will provide an overview of the program and highlight specific areas that are novel with respect to sheep meat.**

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I. INTRODUCTION

THE Australian CRC for Sheep Industry Innovation consists of 5 programs of which program 3 is the Next Generation Meat Quality program. The INF (program 4) is a central resource providing lambs and genetic analyses for program 3. Collection of meat quality and yield phenotypic data from INF lambs will be achieved through a specific project (New phenotypes measured) with the estimation of genetic parameters and molecular breeding values conducted by program 4. With changing consumer demand and more emphasis on the eating quality and nutritive value of meat it is important to ensure that breeding programs do not lead to deleterious effects on these traits and that desirable traits can be incorporated into breeding programs. To ensure consistent results across different sites standardised protocols have been developed for the range of field and laboratory procedures used in the project measuring the new phenotypes [1]. Furthermore calibration procedures have been used to harmonise the results from different laboratories. Slaughter data are being obtained from crossbred progeny with a target carcase weight of 21.5 kg from the following breed crosses: Terminal x Merino ewes and wethers, Border Leicester x Merino wethers and Terminal x Border Leicester Merino ewes and wethers. Additionally, half of the Merino wethers are shorn at 10–11 months of age and then slaughtered as lambs at a target average carcase weight of 21.5 kg. The list of traits being measured and the importance and application of these traits is given in Table 1. These traits will be measured for 2000 progeny per year.

II: OVERVEIW

A. *Lean meat yield*

Lean meat yield (LMY) is an important economic trait for processors because fat and bone are of little value with more fat and bone resulting in a lower lean meat yield. For example, using published data [2], if two carcases each weigh 21.5 kg but one has a GR fat measure of 10 mm and the other 20 mm, then there is a 5.6% decrease in lean meat yield for the fatter carcase, which in 21.5 kg equates to 1.2 kg of lean meat (at $10AUS/kg this is a $12 difference). Samples for eating quality acceptability and nutritional value are being taken from the short loin and hind leg, so components of these two primals are being weighed for the purpose of estimating LMY, using an approach previously published [3]. The predictive models for LMY are being derived by CT-scanning a subset of INF carcases. Models are being developed to predict the lean content using the relevant traits listed in Table 1, and in turn these models will be used to provide LMY estimates for all INF slaughtered lambs.

B. *Consumer appeal*

Some consumers use meat colour as a visual cue for freshness [4] and this impacts on purchasing decisions. Further, consumers find the browning of meat caused by metmyoglobin unappealing. The formation of metmyoglobin during display can be studied by measuring the reflectance of light from the surface of meat and deriving the wavelength ratio at 630/580nm (oxy/met). Some have suggested that consumers of lamb discriminate against the meat when the oxy/met value falls below 3.5 [5] and so the change in oxy/met during shelf display is being measured on a subset of carcases.

C. *Eating quality*

The three factors that determine meat tenderness are 'background toughness', the toughening phase and the tenderisation phase. While the toughening and tenderisation phases take place during the post-mortem storage period, background toughness exists at the time of slaughter and does not change during the storage period. This toughness is linked to connective tissue content and previous research has shown that in a cut like the topside selection for muscling can lead to an increase in toughness [6]. Additionally, this cut has low eating quality [7] and for this reason the compression and connective tissue of the topside is being examined. Data analysis will reveal the genetic relationship between muscling and toughness attributes. Another important trait that impacts on eating quality is intramuscular fat (IMF) [8] and there is some evidence that selection for muscling reduces this trait [9]. Establishing the genetic relationships between these traits is important to ensure breeding objectives do not compromise the market acceptance of lamb.

D *Nutritive value*

Achieving levels of iron (Fe), zinc (Zn) and omega-3 fatty acids that reach recommended dietary guidelines (i.e. a good source) has been proposed as a key marketing tool for red meat into the future [10]. Data suggest that lamb contains adequate levels for Zn, but that Fe and omega-3 need improvement. For example, the current data suggests that a 135 g serving of lean lamb contains 2.7 mg of Fe with the recommended dietary intake (RDI) being 8 for all men and for women over 50 years of age. However for younger women the RDI is 18 mg [11]. Since a 'good source' is considered to provide 25% of the RDI [12] there is room to improve Fe levels for younger women. Further to this, previous data on Fe levels (D. Pethick *unpublished data*) indicate lamb could be vulnerable to lower than the expected Fe levels published previously [12] and given a general decrease in aerobicity (due to an increase in muscling) would lead to a decline in Fe levels. This is not a desirable outcome for lamb and we must prevent any decline in Fe levels. By contrast the RDI for Zn is 14 mg for men and 8 mg for women [11] and given a 135 g serve of lean lamb contains 6 mg of Zn [12] then this is a 'good source' of Zn.

Newly introduced nutrient reference values indicate that most Australians need to increase their intake of the long-chain n-3 polyunsaturated omega-3 fatty acids so as to reduce the risk of chronic disease [13]. These fatty acids include eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and docosapentaenoic acid (DPA), but unfortunately DPA can not currently be included in the nutrient content claim for omega-3 under the Food Standards Code [13]. Current Food Standards in fact favour fish over red meat because red meat contains relatively high levels of DPA compared to fish. Based on current data, it appears that the level of all three fatty acids in 135 g of lean lamb is approximately 97 mg [12] with the RDI ranging from 90 to 160 mg for women and men respectively [11]. Recent data for the loin from 14 month old sheep had the level at 95 mg [13] in close agreement with other published data [12], but the level of the omega-3 does appear to vary across cuts [12]. Even if only EPA and DHA can be claimed lamb can still be considered a source of omega-3 on average. Given the importance of Fe, Zn and the omega-3s they are being measured on all slaughtered progeny and the scale of the program is a world first with the intention of better understanding the levels of these key nutrients and how management and genetics impact on the levels.

In sheep, a preliminary Australian value for heritability of EPA content of muscle is 0.17 [14] and from UK research a value of 0.21 has been reported [15]. This heritability value is moderate, but nevertheless indicates that selection for increased EPA concentration is feasible. No genetic parameters determined under Australian conditions exist for docosahexaenoic acid which is another important omega-3 fatty acid, although a heritability of 0.13 has been reported from UK work [15]. Genetic parameters for these traits will be derived in the program based on data from INF animals.

III. CONCLUSION

The project to measure the phenotypes within the meat program will develop improved models to examine the relationships between carcase and meat traits and contribute to the development of genetic parameters for new and novel meat traits. This will ensure that selection for production traits does not lead to deleterious effects on the quality traits for which lamb has a marketing edge.

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TABLE 1: Carcase and meat traits being measured on INF slaughter progeny.

Trait	Application and Importance
Skin assessment	Consumer acceptability
Hot carcase weight	Lean meat yield prediction
GR, Fat C and Fat 5th rib depths	Lean meat yield prediction/consumer acceptability
Eye muscle area	Lean meat yield prediction
Weight of shortloin subcutaneous fat	Lean meat yield prediction
Weight of boneless short loin muscle	Lean meat yield prediction
Weight of topside muscle	Lean meat yield prediction
Weight of round muscle	Lean meat yield prediction
Weight of hind leg bone	Lean meat yield prediction
Rate of pH decline	Eating quality acceptability
ICDH enzyme activity	Biochemistry
Fresh 24 hr meat colour	Consumer acceptability
Ultimate pH	Consumer/eating quality acceptability
Shear force of the loin muscle (1 and 5 day aged)	Eating quality acceptability
Compression of the topside muscle	Eating quality acceptability
Connective tissue content of the topside muscle	Eating quality acceptability
Intramuscular fat of the loin muscle	Eating quality acceptability
Myoglobin content of the loin muscle	Biochemistry
Iron & zinc content of the loin muscle	Nutritional value
Long chain fatty acids (Omega-3s) of the loin muscle	Nutritional value
Retail colour stability of the loin muscle	Consumer acceptability