GENETIC EVALUATION OF THE TEXEL BREED IN URUGUAY: I. CARCASS QUALITY TRAITS

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Abstract –Due to the relevance of carcass and meat quality traits as breeding objectives of Texel as sire terminal breed, a progeny testing was implemented. In general, these difficult to measure traits have received less attention despite their economic relevance, particularly in more extensive environments in which sheep production is mainly located. Carcass traits were recorded on 424 female and male lambs: Hot Carcass Weight (HCW), most valuable cuts (French Rack, Shoulder and Leg weights), morphometrics traits (Carcass and Leg length, Leg Circumference) and GR (indicator of carcass fatness). Traits as Scanning weight, Rib Eye Area and Fat Thickness are routinely *in vivo* recorded in the genetic evaluation system and genetic parameters were estimated with 3.109 records by a multivariate analysis. Estimated Progeny Difference (EPD) for *in vivo* and *post-mortem* carcass traits was performed. Heritability estimates were of moderate to high magnitude, in agreement with other studies. Although results confirm that there is a scope for genetic improvement, these preliminary values should be interpreted with caution because of the low number of animals. All correlations between EPD were positive and favourable except for fatness traits that depend heavily on factors such as the production system and the target market.

I. INTRODUCTION

Compared to others species (i.e. swine, catlle) very few studies have reported genetic parameters for lamb carcass and meat quality traits [1]. As a consequence of the increased consumer´s emphasis on meat quality, sheep breeders and sheep breeding companies are more interested on meat quality traits and the possibility for implementing these traits into breeding programmes [2]. Nevertheless, the development of new attributes of lamb meat and their inclusion in genetic improvement programmes requires a detailed understanding of the extent of genetic variation influencing relevant carcass composition and meat quality traits. However, it is a challenge to efficiently record meat quality traits at acceptable costs [1]. Genetic variation exists for some carcass and meat quality traits, as reviewed by various authors (e.g. [3], [4], [5]); In general, these difficult-to-measure traits have received less attention despite their economic relevance, particularly in more extensive environments in which sheep production is mainly located. Since 2008, due to the relevance of growth, carcass and meat quality traits as breeding objectives of Texel as sire terminal breed, a genetic evaluation system (GES) for these traits was implemented in Uruguay. As a fundamental component of the GES, the Central Progeny Testing (CPT) was established in the stud-flock “La Aripuca” located in Treinta y Tres (longitude 32º S and latitude 54ºW) [6]. The main goals of the CPT are to facilitate genetic linkage between studs-flocks, and to allow genetic evaluation of carcass and meat quality traits. It is possible because all male lambs and an proportion of the female lambs are slaughtered and individual records of several traits are registered.

The aim of this study was to obtain the estimations of genetic parameters and breeding values for *in vivo* and *post-mortem* carcass quality traits of Texel breed raised on grazing conditions.

II. MATERIALS AND METHODS

Animals and information. Carcass quality data were recorded on 424 female and male lambs from the CPT, which were slaughtered between 2009 and 2013 with an average of 38.9 kg liveweight and 3.5 of body condition. Pedigree data for carcass quality traits comprised 982 animals including 23 sires and 318 dams. The following traits were measured: Hot Carcass Weight (HCW, kg); tissue depth (as an indicator of carcass fatness) (GR, mm); weights of the most valuable meat cuts: French Rack (Rack, g), Shoulder with bone (Shoulder, g) and boneless Leg (Leg, g) weights; and morphometrics traits: Carcass length (CL, cm), Leg length (LL, cm) and Leg Circumference (LC, cm).

In addition, heritabilities and genetic correlations for *in vivo* carcass traits: scanning weight (SWT, kg), Rib Eye Area (REA, cm^2), and Fat Thickness (FT, mm) were estimated with 3.109 records from a total of 9 stud-flocks (including the CPT). Pedigree data for *in vivo* carcass traits included 3.109 animals (56 sires and 1.825 dams). These traits are routinely *in vivo* recorded and evaluated in the genetic evaluation system at an average age of 255 days (Ciappesoni and Gimeno, 2013). Ultrasound live traits (REA and FT) were collected using an Aloka SSD 500 unit, equipped with a 3.5 MHz, 17.2-cm linear array transducer (Aloka Co. Ltd., Tokyo, Japan), between the 12th and 13th ribs. Images were interpreted through the Biosoft Toolbox® offline interpretation software (Biotronics Inc. version 2.1).

Data analysis. Univariate analyses for heritability (h^2) estimation were performed, with the GIBBS2F90 computer package [7]. Multivariate analysis was carried out for the *in vivo* traits. For all traits, after preliminary analysis, it was decided to run a single chain of 1.000,000 iterations. The first 500,000 iterations were discarded and the sampling interval was 20, so that a total of 25.000 samples were kept to estimate features of posterior distributions. The posterior median, the posterior standard deviation (PSD), and highest posterior density interval at 95% (95%HPD) of the estimated marginal posterior distribution were calculated. The animal model included year-flock, birth type, sex, dam age and age at slaughter (covariate) as fixed effects.

Estimated Progeny Differences (EPD) for *in vivo* and *post-mortem* carcass traits were estimated using the software BLUPF90 [7] and the previous heritability estimations. Correlations between EPDs of the different traits for the lambs with *post-mortem* records (n=424) were calculated. Associations between main EPDs of rams used in the CPT flock (n=23) were plotted.

III. RESULTS AND DISCUSSION

Descriptive statistics for *in vivo* and *post-mortem* carcass traits are presented in Table 1. Carcass traits routinely recorded *in vivo* (i.e. SWT, REA, FT) showed moderate heritability values with the lowest value for REA and high genetic correlations between them (Table 2).

Table 1 Descriptive statistics for *in vivo* and *post-mortem* carcass traits.

Trait	n(2)	Mean	Sd	Min	Max
Sc. age (days) (1)	3109	259	27	182	316
SWT (kg)	3094	35.52	7.79	16.80	75.00
REA (cm^2)	3081	9.6	2.9	3.0	24.7
FT (mm)	3071	2.5	1.0	1.0	10.5
St. age (days) (1)	424	292	19	265	328
HCW (kg)	421	18.02	3.83	9.6	30
Rack (g)	420	889	230	395	1488
Leg (g)	421	3605	978	1760	6176
Shoulder (g)	419	3433	812	1445	5688
CL (cm)	422	63.5	5.0	51.0	75.0
LL (cm)	422	43.5	11.6	33.0	71.0
LC (cm)	421	56.4	10.4	35.0	72.0
GR (mm)	420	5.2	3.6	0.0	18.0

(1) Scanning (Sc.) and Slaughter (St.) age. (2) n, number of records; sd, standard deviation; Min, Max, minimum and maximum values.

Positive correlations between these traits were reported by several authors as reviewed by Safari *et al.* [3]. Negative values mentioned in that review generally correspond to correlations between SWT and REA or FT adjusted by weight.

Table 2 Estimated marginal posterior median (posterior standard deviation) for heritabilities (in the diagonal) and direct additive correlations between *in vivo* carcass traits

	SWT (kg)	REA (cm^2)	FT (mm)
SWT (kg)	0.327 (0.062)	0.545 (0.121)	0.537 (0.115)
REA cm2)		0.191 (0.049)	0.559 (0.125)
FT (mm)			0.380 (0.071)

Post-mortem carcass quality traits in Texel sheep in Uruguay have moderate to high heritability values (Table 3), indicating there is scope for genetic improvement in these traits. Medium to high heritability values were also reported for carcass traits by others authors (e.g. [8], [9]). Lower heritability values were cited for HCW by other authors ([4], 0.20±0.06; [9] 0.25±0.04). However, similar heritability was reported by Karamichou *et al.,* [8] (0.47±0.19). Heritability for morphometric measurements as

CL, LL, LC showed moderate and high heritabilities (Table 3). Botkin *et al.* [10] reported similar estimates for CL (0.50± 0.12 and 0.44±0.23). These results should be interpreted with caution because of the small number of animals recorded, which is reflected in large credible intervals (95 % HPD).

Table 3 Estimated statistics of marginal posterior distributions of h^2 estimates for carcass traits.

Trait	Median	PSD	95%HPD_L	95%HPD_U
HCW (kg)	0.483	0.182	0.166	0.857
Rack (g)	0.713	0.159	0.421	0.995
Leg (g)	0.344	0.159	0.054	0.652
Shoulder (g)	0.396	0.154	0.124	0.713
CL (cm)	0.394	0.173	0.082	0.745
LL (cm)	0.507	0.172	0.188	0.855
LC (cm)	0.263	0.162	0.011	0.592
GR (mm)	0.273	0.140	0.029	0.554

PSD: posterior standard deviation; 95%HPD: 95% highest posterior density interval Lower & Upper bound.

As showed in Table 4, all correlations between EPDs were positive and favourable. The exception could be the correlations with fatness traits (GR and FT), depending on the selection objective. Increasing SWT and REA by selection will cause a correlated increase in FT and GR, that could be favourable, neutral or unfavourable depending on the current phenotypic levels of carcass fat of pure and crossbreed lambs, as well as the production system and market specifications. The HCW EPD presented high correlation coefficients with valuable cuts EPD for Rack, Leg and Shoulder (Table 4).

Table 4 Pearson correlation coefficients between EPD of animals with *post-mortem* records (n=424).

Correlation	SWT (kg)	REA (cm2)	FT (mm)	HCW (kg)	CL (cm)	LC (cm)
REA (cm^2)	0.46	-	-	-	-	-
FT (mm)	0.53	0.46	-	-	-	-
HCW (kg)	0.63	0.54	0.28	-	-	-
CL (cm)	0.59	0.33	0.24	0.59	-	-
LL (cm)	0.53	0.31	0.20	0.54	0.45	-
LC (cm)	0.54	0.42	0.13	0.73	0.59	-
Rack (g)	0.52	0.50	0.25	0.77	0.52	0.70
Leg (g)	0.53	0.45	NS	0.80	0.56	0.83
Shoulder (g)	0.67	0.49	0.28	0.81	0.67	0.77
GR (cm)	0.27	0.32	0.36	0.41	0.24	0.23

Note: NS… correlation non-statistically different from zero (p>0.01).

In addition, cut weights also presented high correlations with REA EPD. In the case of the Leg, this is very interesting because it is a cut that does not include the *Longissimus dorsi* muscle, measured by REA.

Figures 1-5 show the association between EPDs of the main traits for all evaluated rams (n=23).

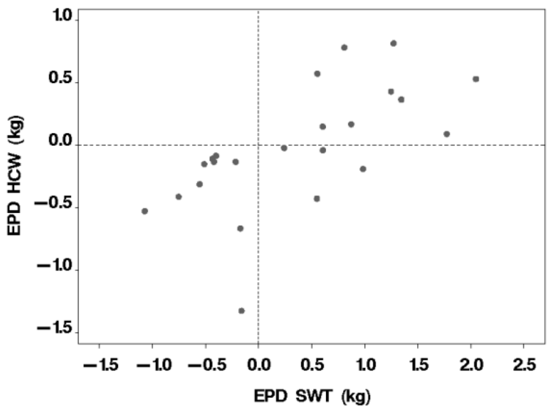

Figure 1. Association between ram EPD of HCW (kg) and scanning weight (SWT, kg).

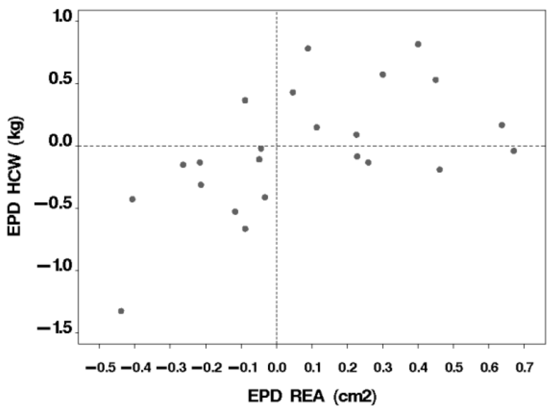

Figure 2. Association between ram EPD of HCW (kg) and Rib Eye Area (REA, cm2).

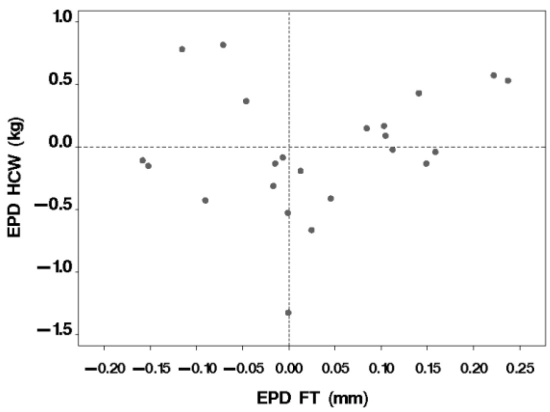

Figure 3. Association between ram EPD of HCW (kg) and Fat Thickness (FT, mm).

Although traits are correlated, the magnitude of the correlations allow selecting for multiple objectives even when correlations could be considered unfavourable (e.g. increase SWT and maintain FT).

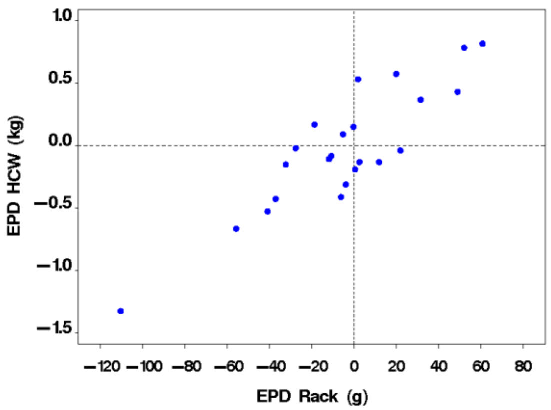

Figure 4. Association between ram EPD of HCW (kg) and Frech Rack weight (Rack, g).

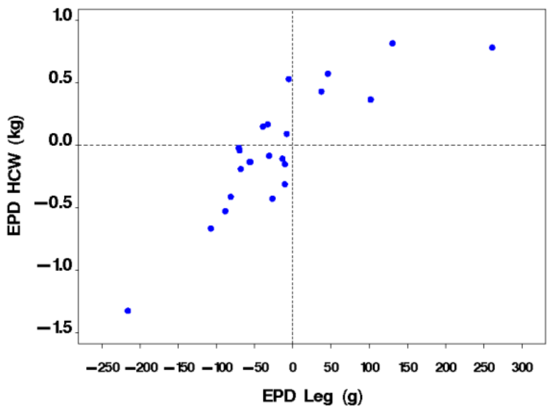

Figure 5. Regression between ram EPD of HCW (kg) and Leg weight (g).

IV. CONCLUSION

In order to improve carcass weight and quality traits, currently published EPDs (i.e. SWT, REA and FT) could be used, due to the positive correlations between EPDs of *in vivo* and *post-mortem* traits. Although there is a general trend of reducing meat fat, evaluated lambs in this study did not present a high degree of fatness, probably due to the leanness of the breed. This emphasis the relevance of evaluating selection objectives taking into account the differences between production and crossbreeding systems, and demands from global or niche markets.

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