GROWTH, CARCASS AND MEAT QUALITY EVALUATION OF POLWARTH AND CROSSBREED LAMBS

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Abstract – The objective of this study was to evaluate the influence of sire breed (Polwarth=P, Poll Dorset=PD and East Friesian=EF) on growth, carcass and meat quality traits of lambs born to wool type ewes. A flock of multiparous Polwarth ewes was mated with connected P, EF and PD rams during three consecutive years. PD cross lambs had higher weaning, slaughtering and carcass weight and growth from birth to weaning and from weaning to slaughtering compared to the other biotypes evaluated. They also presented a higher subcutaneous fat depth at the GR point and weight of valuables cuts (Leg and Rack) but these differences disappear when the comparisons are done at constant carcass weight. PD cross lambs also presented a higher proportion of superior carcass (S) according to INAC system. EF cross lambs presented a lower subcutaneous fat depth at the GR point independently of the carcass weight that is a particular genetic characteristic of this breed. The lambs carcasses produced in this experiment achieved most quality parameters for our international markets with the exception of the subcutaneous fat depth which is under the market requirements. Some alternatives to increase the GR are presented and discussed.

I. INTRODUCTION

In the last two decades, important changes took place in the Uruguayan sheep productive systems. Meat and specially lamb has consolidated as a productive alternative, complementing and in many cases, attaining more relevance than wool, which was for many decades, the principal product of Uruguayan traditional sheep systems [1]. In this scenario, reproductive efficiency, lambs growth rate and the price farmers gets for their product (associated to the product´s quality) are the most important parameters that insides on the farmers´ economic equations [2].

The incorporation of maternal and terminal biotypes has demonstrated to be a tool of high utility to improve the reproductive and productive performance of Uruguayan flocks [3].

With these objectives, new breeds have been introduced to our country. One of them was Poll Dorset that is used worldwide under terminal crossbreeding due to its high growth rate and meat and carcass quality obtained in these lambs.
East Friesian breed, also introduced to our country, is used under intensive lamb production systems as a maternal biotype due to its good maternal ability and high ovulation rate.
The objective of this study was to evaluate the influence of sire breed (Polwarth, Poll Dorset and East Friesian) on lambs´ growth, carcass and meat quality traits.

II. MATERIALS AND METHODS

The experiment was done at the Sheep Unit of INIA La Estanzuela, Uruguay (34°19´57´´S and 57°40´07´´W), from March 2004 until November 2007 including three generations of lambs evaluated.

A flock of multiparous Polwarth ewes (wool type) was mated with Polwarth (Ideal) (P), East Friesian (EF) and Poll Dorset (PD) rams during three consecutive years, using a minimum of three rams of each breed per year. One ram of each breed used one year, was used the following one as a genetic link.

All lambs obtained by the cross breeding (PDxP, EFxP and PxP) were evaluated from birth until slaughtering. The traits evaluated included:
Growth traits: birth weight of live born lambs (BWT, n=507), weaning weight at 72 ± 17 days of age (WWT, n=507), and slaughtering weight at 382 ± 22 days of age (SWT, n=496), growth from birth to weaning (GBW, n=507), and from weaning to slaughter (GWS, n=496).

Carcass traits: Hot Carcass Weight (HCW, kg, n=234); tissue depth (as an indicator of carcass fatness) (GR, mm, n=298**;** weights of the most valuable meat cuts: French Rack (Rack, g, n=232),

and boneless Leg (Leg, g, n=234) weights were measured according to Robaina [4].
Lambs carcasses were classified with the subjective grading system developed by the National Meat Institute (INAC) and used for heavy lambs with four classes of conformation (decreasing from S-excellent, P-good, M-medium, to I-poor) and three classes of fat finish (increasing from 0-total absence to 2-excesive covering).

Meat quality traits: Meat color was measured on the cut surface of the *Longissimus dorsi* with a Minolta Chroma meter (Model C-10). Parameters (n=130) L* (relative lightness), a* (relative redness) and b* (relative yellowness) were assessed 60 minutes after the surface was exposed. Warner Braztler Shear Force (WBSF, kgF, n=130) was measured on *Longissimus dorsi* muscle after five days of aging.

For statistical analysis, the breed type means were estimated by analysis of variance with the fixed effects of the breed type (B, 3 levels), year of birth (Y: 2004, 2005, 2006), sex (S: female or male), birth type (BT: single or multiple =twin or triplet), and their interactions (BxS, BxBT; SxBT). Sire effect within breed type was included as random effect. For the analysis of the WWT and GBW the age at weaning was used as covariate. Likewise, for the analysis of SWT and carcass and meat quality traits age at slaughter was included as covariate. For GWS evaluation, days between weaning and slaughtering date were included as covariate.
All traits were analyzed assuming a normal distribution using the procedure MIXED of SAS (Statistical Analysis System, Version 9.2, 2008).
In addition, an alternative weight adjusted (wt adj) model for GR, Rack and Leg with HCW covariate was used to evaluate valuables cuts ratio.

III. RESULTS AND DISCUSSION

PDxP and EFxP lambs had higher BWT ($p<0.05$; Table 1) compared to PxP lambs (0.340 y 0.360 kg respectively) without difference between cross lambs. This difference should be to an additive and individual heterosis effect since their mother were of the same breed, age and consequently similar maternal ambient.

Table 1. Least square means of breed groups for birth (BWT), weaning (WWT), and slaughtering weight (SWT), growth from birth to weaning (GBW), and from weaning to slaughter (GWS).

Trait	PxP	EFxI	PDxP
BWT (kg)	4.26 ^{b}	4.62 ^{a}	4.60 ^{a}
WWT (kg)	17.5 ^{c}	18.6 ^{b}	19.5 ^{a}
GBW (kg)	13.3 ^{c}	14.0 ^{b}	15.0 ^{a}
SWT (kg)	40.5 ^{c}	45.8 ^{b}	50.3 ^{a}
GWS (kg)	23.1 ^{c}	27.3 ^{b}	30.6 ^{a}

Note: Different letters in superscript (a, b, c) indicate significant differences in results of the same row ($p<0.05$).

PDxP lambs had 0.9 kg of weight more than EFxP and 2.0 kg more than PxP ($p<0.05$;Table 1).
Similar tendencies were reported in lambs´growth rate between birth and weaning. For this variable, PDxP lambs were 1.0 and 1.7 kg heavier than EFxP and PxP lambs respectively, while the latter lambs were 0.7 kg lighter than EFxP ($p<0.05$; Table 1). In both cases, the difference can be attributed to the genetic merit of the lamb´s sire breed since maternal ambient and the feed availability were the same for all lambs´ biotypes.

At slaughtering PDxP lambs were 9.8 and 4.5 kg heavier than PxP and EFxP lambs respectively ($p<0.05$). Similar results were reported in the growth between weaning and slaughtering. Indeed, in that period, PDxP lambs were 3.3 and 7.5 kg heavier ($p<0.05$; Table 1) than EFxP and PxP lambs respectively

PDxP lambs produced 2.7 kg more of carcass weight compared to EFxP ($p<0.05$) which produced 2.8 kg more of carcass than PxP lambs. Under comparable conditions, similar results have been presented by Ganzábal *et al*. [3] and Bianchi *et al* [5].

In this experiment, the GR (mm) was significantly higher ($p<0.05$) in the PDxP lambs compared to the other evaluated biotypes (Table 2). However, the differences observed in the PDxP and PxP lambs are due to the carcass weight of each biotype. Since, this difference disappeared ($p>0.05$) when HCW was used as a covariable in the statistical model. On the other hand, the carcasses of EFxP lambs had significantly less ($p<0.05$) GR, even when corrected by HCW. These differences were of 2.6 and 1.5 mm between EFxP and PDxP or PxP respectively. East Friesian is a breed recognized to have less subcutaneous fat compared to other breeds and this, has been demonstrated under Uruguay conditions by

Ganzábal *et al.* [3]. This attribute of the EF, assures that even when the carcass are of very high weight, they would not be devaluated because of over fattening.

Table 2. Least square means of breed groups for carcass and meat quality traits.

Trait	PxP	EFxI	PDxP
HCW (kg)	17.0 [c]	19.8 [b]	22.5 [a]
GR (mm)	6.7 [b]	7.6 [b]	12.3 [a]
GR wt adj (mm)	9.2 [a,b]	7.7 [b]	10.3 [a]
Rack (kg)	0.421 [c]	0.483 [b]	0.573 [a]
FR wt adj (kg)	0.494 [a]	0.483 [a]	0.500 [a]
Leg (kg)	1.7 [c]	2.0 [b]	2.2 [a]
Leg wt adj (kg)	1.95 [a]	1.97 [a]	1.93 [a]
WBSF (kg)	2.98 [a]	2.97 [a]	3.19 [a]
L*	40.6 [a]	39.6 [a]	40.3 [a]
a*	14.8 [a]	14.1 [a]	13.6 [a]
b*	10.9 [a]	10.1 [a]	10.9 [a]

Note: Different letters in superscript (a, b, c) indicate significant differences in results of the same row ($p<0.05$).

In Figure 1 are presented all carcasses belonging to the three biotypes identified according to their HCW and depth of the subcutaneous fat (GR). At the same time, it can be observed in the squares the requirements for each variable for the most important markets for lamb meat produced in Uruguay according to Lema [6].

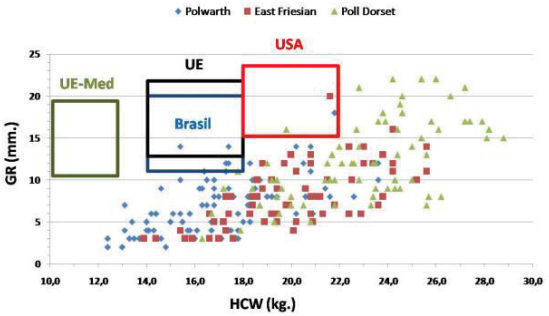

Figure 1. Association between HCW (kg) and GR (mm) by breed and differentiation according to international market supplies.

In general terms, the carcasses obtained in this experiment have GR under the requirements' of most International markets. Possibly, Uruguayan rearing and finishing systems (long periods, based on pastures and lambs slaughtered close to the year of age) privilege growth and not fattening, achieving only some fat by the end of the process.

The Leg (P) and French Rack (FR) were the cuts chosen for the carcass evaluation since they are the cuts that most incidences have on the value of the carcass [7]. The carcasses belonging to PDxP lambs presented Leg and Rack heavier ($p<0.05$) than EFxP lambs (200 and 90 g, respectively) and the latter lambs had Leg and Rack 300 and 62 g heavier ($p<0.05$) than PxP lambs (Table 2). However, these differences were entirely due to the higher carcass weight and not to a higher proportion of these valuable cuts since, this difference disappeared when HCW was used as a covariable in the statistical model.

There were no differences ($p>0.05$) between the three biotypes for meat quality. In all three treatments, the average levels of tenderness were within desirable levels and under the hardness levels considered as a problem [8].

Table 3. Distribution (%) of carcasses according to INAC system (conformation and fat classification) by breed group.

Trait	PxP	EFxI	PDxP
M	14	9	1
P	85	85	70
S	1	6	29
0	1	1	0
1	86	85	55
2	13	14	45

In Table 3, it can be observed that PDxP lambs presented near 30 % of S carcasses, compared to 6 and 1 % for EFxP and PxP lambs. PDxP lambs only presented 1 % of carcasses M compared to 9 and 14 % for the two other biotypes. Within grading, PDxP lambs presented 45 % of carcasses 2-type that is considered optimum. For the same scoring, EFxP and PxP lambs presented 14 and 13 % of 2-type carcasses respectively. All the biotypes presented carcass with adequate finishing levels according to the INAC system [9]. This seems to be a contradiction with the information presented in Figure 1, where a high percentage of carcasses do not fulfill the requirements of the most important export markets.

IV. CONCLUSION

According to the results obtained in this experiment, PD breed is an interesting option to be used as a terminal cross on wool type ewes to increase lambs growth rate and carcass conformation, specially under pastoral conditions as in Uruguay. According to the characteristics of

the carcasses obtained with low levels of GR; it should be considered reducing the slaughtering age by using more precocious breeds with higher growth rate and fattening or consider the use of other complementary feeds like grains during finishing. These managements would avoid prolonged periods of rearing, that slows the productive system and generates difficulties in the finishing of the carcass.

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