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Introduction of sheep meat breeds in extensive systems: Lamb carcass characteristics

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ABSTRACT

Genotype effects on lamb carcass traits were investigated in a 4-year study aimed at assessing potential benefits from introducing meat breeds into the wool-oriented extensive sheep systems of northeastern Patagonia, Argentina. Five ram [Corriedale: CO; Border Leicester: BL; Île de France: IF; Texel: TX; and synthetic CRIII (25% Merino, 37.5% IF, 37.5% TX)] and 5 dam (CO; synthetic CRIII; BLCO: BL × CO; IFCO: IF × CO; and TXCO: TX × CO) genotypes were represented in the study. Data were collected from 436 male lambs of 9 genotypes (CO × CO, BL × CO, IF × CO, TX × CO, CRIII × CO, CRIII × BLCO, CRIII × IFCO, CRIII × TXCO, and CRIII × CRIII). Hot carcass weights and dressing yields were determined after slaughtering. Carcasses were given conformation and subcutaneous fat scores using the EUROP system [scale varying from E (best) to P (poorest) for conformation, and from 1 (lean) to 5 (overfat) for subcutaneous fat]. Linear measurements of carcass length and width were recorded and carcass compactness indices were calculated from those. Purebred CO acted as a standard for comparisons. On a constant liveweight basis, genotypes CRIII × IFCO and CRIII × CRIII presented higher ($P < 0.05$) carcass weight and dressing yield than CO × CO and BL × CO. Crossbred and synthetic genotypes showed higher ($P < 0.05$) carcass width than CO × CO. With the exception of BL × CO the remaining genotypes showed higher ($P < 0.05$) carcass width/length ratio than CO × CO. The probability that carcasses of crossbred and synthetic lambs presented better conformation than CO × CO was higher than 84%. Carcasses of CRIII × IFCO lambs were given the best conformation scores. The probability that BL × CO carcasses presented higher subcutaneous fat than the remaining genotypes exceeded 79%. Our results indicate significant improvements in carcass conformation arising from crossing. Sheep farmers in extensive systems could take advantage of the higher fatness of BL crossbred lambs to produce light carcasses with adequate fat cover, a crucial industry requirement. Terminal crossbreeding with Île de France, Texel, and CRIII rams could be implemented to improve carcass conformation thus matching market demand for heavy carcasses with limited fat content. Second cross schemes did not improve carcass commercial traits over the best terminal cross or the synthetic CRIII breed.

1. Introduction

Patagonian sheep farming has historically focussed on fine wool; lamb and mutton production has been confined

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to the wetter areas of the region (e.g. foothills of the Andes, Atlantic coast and Tierra del Fuego). Meat demand from overseas markets and local packers within the foot-and-mouth disease-free area is increasing. In this new scenario meat production has potential for improving farm income substantially thus contributing to economic and social sustainability of Patagonian sheep farming. However, new markets demand lean heavy carcasses (Rees, 2009) and this is fostering genotype changes in areas suitable for intensifying meat production. Synthetic meat genotypes are gradually spreading and dual-purpose Corriedales, the traditional resource for meat production, are being increasingly interbred with meat and prolific genotypes (Álvarez et al., 2010). Identifying crosses matching particular markets and production systems is required for getting leaner carcasses at optimum slaughter weights (Kirton et al., 1995). An evaluation of available genetic resources is essential to assess their potential for crossing systems exploiting both heterosis and complementarity to meet specific production and market goals. This work reports results on carcass traits from a long-term study aimed at characterizing genotype effects on growth traits, survival, and commercial finishing of lambs (Álvarez et al., 2010). We also report results on some non-genetic effects that may help identify possible strategies for improving management. The study focused on northeastern Patagonia but general findings are probably relevant for other extensive sheep production systems around the world.

2. Materials and methods

Experimental protocols and animal management were carried out in accordance with EU Directive 2010/63/EU for animal experiments (http://ec.europa.eu/environment/chemicals/lab_animals/legislation_en.htm).

2.1. Study site

The study was conducted at the Patagones Research Farm located in northeastern Patagonia (40°39′S, 62°54′W, 40 m a.s.l.), within the phytogeographical Province of the Monte (Cabrera, 1976), Argentina. This is a semi-arid region characterized by shrubby natural vegetation and long-term annual rainfall averages of approximately 300 mm. The mean annual temperature is 14.5 °C with minimum and maximum temperatures usually occurring in August and January, respectively.

2.2. Animals

The gamut of sheep meat breeds readily available in Argentina is rather limited. Genotypes included in the study were those locally available at the time. Five ram genotypes [Corriedale (CO), Border Leicester (BL), Île de France (IF), Texel (TX), and synthetic CRIII] and 5 dam genotypes [CO, synthetic CRIII, BLCO (BL × CO), IFCO (IF × CO), and TXCO (TX × CO)] were represented in the study. Experimental CO ewes came from commercial flocks with production records representative of the breed. The CRIII genotype is a synthetic originated at the Valle Inferior Agriculture Experiment Station (VIAES, located nearby the Patagones Research Farm) by crossing and backcrossing of IF and TX rams on Merino dams. Synthetic CRIII dams are usually heavier (~60 kg) than CO (~53 kg) dams and have an approximate blend of 25% Merino, 37.5% IF, and 37.5% TX (Álvarez et al., 2010). This breed has not been evaluated before for straight breeding nor for terminal crossing.

From 2002 to 2006, CO ewes (n = 182–240) were mated to CO, BL, IF, or TX rams every year. First cross females born in 2002–2004 (i.e., BLCO, IFCO, and TXCO genotypes) were retained and mated to CRIII rams in 2004, 2005, and 2006; CRIII ewes (n = 98–113), in turn, were mated to CRIII rams from 2003 to 2006 (Table 1). Five rams of each CO, BL, IF, and TX breeds and 12 CRIII rams were used in the study. Corriedale, BL, IF, and TX rams were obtained from 3 different local breeders. The CRIII rams came from the experimental VIAES flock. As data were connected across years by ram breed and by rams within ram breed, the design allowed for comparisons among 9 lamb genotypes: CO × CO, BL × CO, IF × CO, TX × CO, CRIII × CO, CRIII × BLCO, CRIII × IFCO, CRIII × TXCO, and CRIII × CRIII; see Álvarez et al. (2010) for further details of experimental design and connectedness.

2.3. Flock management and data recording

Flock management mimicked the annual spring lambing system typical of local flocks. On average, mating started on 25 March and lasted for 34 days. Starting as 18-month-old, ewes were assigned every year to a randomly chosen ram breed and to a random ram within that breed. Animals were treated against internal and external parasites (ivermectin 3%, Vermectin Premium LA, OVER Labs, Buenos Aires, Argentina; 1 cm^3/50 kg bodyweight s.c.) before the onset of the mating season. All ewe genotypes were managed as one flock. Feeding was exclusively grass-based; year-round grazing mirrored a sequence of forage resource use typical of local flocks. During the mating and gestation periods ewes grazed native grassland (~560 kg dry matter/ha per year) and improved wheatgrass pastures (~950 kg dry matter/ha per year), respectively. Two times a day recently lambed ewes and newborn lambs were moved to an oats winter crop paddock (~1800 kg dry matter/ha per year) where they joined previously lambed ewes. Dry ewes grazed oats stubbles.

Ewes were shorn 20 days in advance of the expected date of onset of lambing (19 August on average). Ewe–lamb pairs were identified at birth, and date of birth, sex, birthweight and litter size were recorded. Thereafter and every fortnight until weaning (90 days) lambs were weighed and assessed for body condition score [on a 1 (emaciated) to 5 (obese) scale; Jefferies, 1961]. Starting in 2003, male lambs reaching at weaning both 23 kg or higher and 2.5 points or a higher condition score were considered commercially finished and shipped for slaughtering; female lambs were retained for reproduction.

2.4. Slaughtering and carcass evaluation

Male lambs were slaughtered in a local abattoir following standard procedures including humane desensitization. Individual hot carcass weights were recorded after slaughtering and a dressing yield was calculated as 100 × carcass weight (kg)/liveweight (kg). Carcasses were given conformation and subcutaneous fat scores using the EUROP system (de Boer, 1992) which varies from E (best) to P (poorest) for conformation, and from 1 (lean) to 5 (overfat) for subcutaneous fat. Classes 3 and 4, in turn, admit 2 subclasses each (H for high and L for low fatness). Two different measurements of length and width were recorded (Timon and Bichard, 1965) and used in three indices of leg and carcass compactness. Carcasses were suspended on a gamble to keep a constant separation between the legs and the following linear measures were recorded: carcass length (from tail base to neck base), leg length (from the perineum to the tarsal–metatarsal articular surface), bottom width (width at the level of the proximal edge of the patellae) and carcass width (maximum carcass width at chest height). Indices of carcass compactness (carcass weight/length), leg compactness (bottom width/leg length) and carcass width/length ratio (Bibe et al., 2002) were calculated for each carcass.

2.5. Statistical analyses

Basic edits eliminated records of lambs with unknown parents and implausible lambing or weight records (usually associated with mismothering; less than 1% of cases). Data from 436 male lambs slaughtered from 2003 to 2006 were available for analyses.

All linear measurements plus carcass weight and dressing yield were analyzed using linear mixed models. Exploratory analyses identified main factors and interactions to be included in the reduced models. In commercial farms lambs are shipped for slaughtering at a target liveweight. Hence we decided to include liveweight or carcass weight in the statistical models to identify factors other than weight contributing to differences between genotypes. Liveweight and carcass weight showed non-linear relationships with some traits; they were quantized into four levels (1: value < $\mu - \sigma$; 2: $\mu - \sigma \leq$ value < μ; 3: $\mu \leq$ value < $\mu + \sigma$; 4: value $\geq \mu + \sigma$) for inclusion as fixed effects. Not unexpectedly, factors usually affecting lamb growth traits such as lambing period or dam body condition (Álvarez et al., 2010), did not reach statistical significance after liveweight or