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Reproduction Efficiency and Health Traits in Dorper, White Dorper, and Tsigai Sheep Breeds under Temperate European Conditions

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ABSTRACT: The objective of the current pilot study was to evaluate the reproductive performance and health indicators in Dorper, White Dorper, and Tsigai breed ewes managed semi-intensively under European temperate conditions. A total of 544 ewe-year units were observed, with ewes (ranging from 1.5 to 8 years of age) managed under identical rearing conditions for a period of two consecutive production cycles (2012 through 2013 and 2013 through 2014). In general, significant ($p\leq0.001$) genotype-related disparities were found in occurrence rates for all health parameters taken into study. Clinical mastitis incidence was significantly lower ($p\leq0.05$) in Dorper (9.4%) and White Dorper (10.8%) breeds compared to that of Tsigai ewes (17.4%). Significant differences ($p\leq0.05$) for lameness were found between Dorper and Tsigai breeds, with occurrence rates of 8.0% and 2.9%, respectively. Incidence for pneumonia and abortion was not influenced ($p>0.05$) by the ewes' genotype. Litter size was significantly lower ($p\leq0.05$) in White Dorper breed than for Dorper and Tsigai ewes, of 1.21, 1.40, and 1.45, respectively. Conception rates and lambs survival were not affected ($p>0.05$) by genotype. Results suggest that South African Dorper and White Dorper sheep breeds have adapted well to the specific rearing conditions. (**Key Words:** Sheep, Genotype, Fitness, Health, Performance, Reproduction)

INTRODUCTION

Poor flock health and reproductive outputs constrain decidedly sheep productivity and welfare (Matheson et al., 2012; Gowane et al., 2014). With genetic selection for reproductive performance and resistance to diseases being often overlooked and regarded as time-consuming due to the low additive genetic variances and heritabilities of the traits (Notter, 2012; Zishiri et al., 2013).

In order to formulate proper animal health management and effective disease control measures, accurate estimates of the extent and prevalence of the diseases are required (Cross et al., 2010; Willeberg, 2012). However, the literature on adult ewe's fitness characteristics is limited (Borg, 2007). Furthermore, knowledge of the occurrence rates of various health disorders is important for both veterinarians and researchers, in order to set-out, alarm thresholds', which will then help sheep breeders to monitor flock's health and in the decision making process.

Exotic specialized breeds are often introduced into various rearing systems without adequate knowledge on their acclimatization to those specific conditions (Browning et al., 2011), which can lead to poor efficiency in sheep production (Hristov et al., 2013).

Recently, Dorper germplasm has been widely distributed across the globe, however, there is little information on the breed's reproduction performance and adaptation (Scanlon et al., 2013; Alemseged and Hacker, 2014), especially outside native South Africa.

Tsigai is a traditional triple-purpose sheep group, widely distributed across regions of Central, Eastern and Southern Europe (Cinkulov et al., 2008). Production levels vary greatly among countries and regions which rear Tsigai sheep (Kusza et al., 2008).

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To the best of our knowledge, no other comparative study concerning the reproduction and health traits of Dorper and White Dorper breeds under semi-intensive European rearing conditions exists up to this moment. Furthermore, this is the first attempt to define fitness traits in the Tsigai breed.

The objective of the current pilot study was to evaluate the reproductive performance and health indicators in Dorper, White Dorper, and Tsigai breed ewes managed semi-intensively under European temperate conditions.

MATERIALS AND METHODS

Location and flock management

The study was carried out at the Experimental Farm of the University of Debrecen. Dorper, White Dorper, and Cokanszki Tsigai purebred ewes were included in the study and managed semi-intensively under identical rearing conditions for a period of two consecutive production years (Table 1).

Ewes were between 1.5 and 8 years old, with age and parity balanced across breeds and representing a diverse sampling of genetic lines within each breed. The project herd in the first year consisted of 65 Dorper, 30 White Dorper, and 175 Tsigai ewes, and in the second year of 73 Dorper, 26 White Dorper, and 175 Tsigai ewes. No external ewes were included in the experimental herd. All replacement ewes for the 3 breeds were produced and added to the breeding herd at the age of 1.5 years. The production year started at 1st of September, when the ewes were put to ram (for 3 consecutive oestrous cycles, roughly 55 days) and ended in late August.

Debrecen region has a typical Central European humid continental climate, with the research station being located at an elevation of 121 m above sea level and a total annual precipitation of 566 mm, with a mean annual temperature of 9.85°C. Temperatures express seasonal patterns with summer daily means of 20.3°C in July and winter daily means of –2.6°C in January.

Table 1. Number of ewes in the study herd and data on the experimental conditions

Items	Breed		
	Dorper	White Dorper	Tsigai
Production year			
2012 to 2013	60	30	175
2013 to 2014	73	26	175
Experimental conditions			
Location	47°33'N/21°42'E		
Reproduction season	1st of September (55 days)		
Indoor housing	Year around		
Mean annual temp.	9.85°C		
Lambs creep fed	*ad libitum*, 16% crude protein pellets		
Altitude of the site	121 m		
Age at first mating	1.5 years		
Annual precipitation	566 mm		
Summer/winter	20.3°C July / –2.6°C Jan.		
Lambs weaned at	80 days		

Both ewes and their lambs were kept confined on deep straw bedding, with a space allowance of 1.2 m^2 and 1 m^2, respectively. With permanent access to outside paddocks during daytime (2 m^2/animal) and occasionally allowed to graze on a cultivated pasture situated next to the sheep barn (on average 8 to 10 weeks/year), for health and welfare reasons. Ewes received high-quality alfalfa and lolium hays *ad libitum*, as well as 1.5 kg of corn silage/head (except for the last month of gestation), with an additional 200 g concentrate in late gestation and during lactation period. Lambs were creep fed (*ad libitum*, 16% crude protein pellets) and weaned at 80 days of age. Nutritional flushing was practiced at the R&D Station for three weeks before each of the two mating seasons, with the ram/ewe ratio of roughly 1:20. In addition, all animals had free access to potable water and mineral blocks year around.

The research activities were performed in accordance with the European Union’s Directive for animal experimentation (Directive 2010/63/EU).

Data and statistical analysis

Occurrence rates of the following health disorders were recorded by the research stations veterinarian: mastitis, lameness, pneumonia and abortion. Annual attrition rates were determined by identifying ewes in the herd at the start of the production year not present in the herd at the end of the production year. Death and culling because of all reasons were included when evaluating attrition rates. Data on the reproductive performance of ewes (conception rate, litter size and survival rates of un-weaned lambs) were recorded for all three breeds.

In order to assess the effect of the genotype (breed) on the above-mentioned health disorders, as well as on the reproduction performance of the ewes, the STATISTICA software was used (Hill and Lewicki, 2007). The Main Effect ANOVA analysis of variance was applied. Given that data was recorded during two consecutive production cycles, the model included this as correction factor. The model used for statistical analysis is presented below:

$$y_{ijk} = \mu+pc_i+g_j+e_{ijk}$$

where y_{ijk} is the studied reproduction or health trait; μ is the overall mean; pc_i represents the fix effect of production cycle with two levels: 2012/2013 and 2013/2014; g_j represents the random effect of the genotype with three levels: Dorper, White Dorper, and Tsigai; and e_{ijk} is the residual effect. When significant effects of the genotype

Table 2. Least squares means (±standard error) for occurrence rate of mastitis, lameness, pneumonia and abortions in Dorper, White Dorper, and Tsigai ewes

Breed	Mastitis (%)	Lameness (%)	Pneumonia (%)	Abortion (%)
Dorper	9.4±3.01[a]	8.0±1.74[a]	4.3±1.65[a]	3.6±1.53[a]
White Dorper	10.8±1.89[a]	5.3±2.74[a,b]	5.4±2.58[b]	3.6±2.40[b]
Tsigai	17.4±1.89[b]	2.9±1.09[b]	3.4±1.03[c]	3.1±0.96[c]

[a,b,c] Column means with different superscripts differ significantly at p≤0.05.

were observed, the comparison among breeds was tested by performing contrast analysis, using Tukey test.

RESULTS AND DISCUSSION

Generally, notable genotype-related disparities were found, with ewes breed significantly influencing (p≤0.001) the occurrence rates for all health parameters taken into study.

Taking into account the clinical mastitis occurrence rate, the two Dorper genotypes were less affected (p≤0.05) compared to Tsigai ewes (Table 2). Results are consistent with estimates of Giadinis et al. (2011), which report occurrence rates for mastitis of over 10% for commercial sheep flocks. Furthermore, occurrence rates of over 30% in European dairy flocks are being frequently mentioned in the literature (Bergonier et al., 2003; Bishop et al., 2010). Thus, it was considered that mastitis has a negative impact on ewe stayability, milk yield, lambs growth and survival, veterinary costs and representing a major concern for welfare. Importance of clinical mastitis in the Europe was highlighted by Ligda et al. (2003), which found mastitis to be the main cause for culling in the Greek sheep industry, accounting for 46% of the attrition cases. Current study highlights the low resistance to clinical mastitis of the Tsigai breed. As a result, measures such as including the genetic resistance to mastitis as a trait into the breed's selection index should be taken.

Lameness occurrence rate during the two years was 8.0%, 5.3%, and 2.9% in Dorper, White Dorper and Tsigai ewes, respectively. This is in accordance with estimates of FAWC (2011) for the English flocks, which range from 8.4% to 10%. Significant differences (p≤0.05) were observed between Dorper and Tsigai breeds. It is expected for both the Dorper genotypes and Tsigai breed to be less affected by lameness under pasture-based extensive rearing systems. Conversely, in the current study ewes were kept on deep straw litter, which does not allow the claws to naturally wear off and the litter might sustain microbial populations which lead to an increased rate of lameness, as previously demonstrated in dairy cows by Barker et al. (2010).

Given the low winter temperatures reached in Hungary, pneumonia incidence in Dorper genotypes is of concern to both scientists and breeders, being hair breeds and originating form a divergent climate. However, breed differences for pneumonia were not significant (p>0.05), these results being encouraging for the further introduction of the Dorper and White Dorper breeds to commercial flocks. No available data for comparison on pneumonia occurrence in European countries was found, except for information on flocks infected with Maedi-Visna (Benavides et al., 2013).

Occurrence rate of the abortions was not influenced by genotype (p>0.05). According to previous reports, in healthy flocks abortion accounts for less than 2%, with 5% occurrence rate being considered as an alarm threshold (Menzies, 2011). Out of the four health disorders studied, abortion has to have the most significant economical and welfare implications, given that abortion will most likely result in culling or death of the ewe.

The ability to become pregnant and deliver live lambs represents the first quantifiable component of the ewe reproductive performance and it is of utmost importance when rearing sheep for meat production. With Dorper and White Dorper breeds expressing similar conception rates (p>0.05) to indigenous Hungarian Tsigai ewes (Table 3). Conception rates of Dorper breed were lower than those reported by Cloete et al. (2000) and Gavojdian et al. (2013), and consistent with estimates reported by Schoeman (2000). Results suggest that the two Dorper genotypes have adapted well to the specific housing and feeding conditions found in Hungary. Conception rates for the Tsigai ewes were lower than those estimated by Krupova et al. (2009) for the breed.

Table 3. Least squares means (±standard error) for reproductive performance and attrition rates in Dorper, White Dorper, and Tsigai ewes

Breed	Conception rate (%)	Litter size (lambs)	Lambs weaning rate (%)	Attrition rate (%)
Dorper	81.04±3.10[a]	1.40±0.05[a]	94.0±2.01[a]	9.0±2.91[a]
White Dorper	86.7±4.86[b]	1.21±0.08[b]	90.3±2.91[b]	6.8±4.56[a]
Tsigai	82.8±1.94[c]	1.45±0.03[a]	95.6±1.40[c]	17.1±1.82[b]

[a,b,c] Column means with different superscripts differ significantly at p≤0.05.

Compared to White Dorper breed, Dorper and Tsigai ewes produced significantly higher litters ($p \leq 0.05$ and $p \leq 0.01$, respectively). Average litter size in Dorper ewes was consistent with reports of Zishiri et al. (2013) for the breed in native South Africa and those of Assan and Makuza (2005). Considerable lower values for litter size in Tsigai are reported by Krupova et al. (2009) and Padeanu et al. (2012). Higher litter size in Tsigai ewes during current trial might be attributed to the good feeding and management conditions. In addition, during previous studies, ewes were reared for both meat and milk productions, while in the current experimental flock ewes were lactating for only a short period of time (80 days), until the lambs were weaned. This might have lead to a better body condition of ewes during mating season and thus to higher ovulation rates.

Lambs weaning rates were not influenced by genotype ($p>0.05$). This finding is consistent with reports of Gavojdian et al. (2013) for Dorper lambs and Padeanu et al. (2012) for Tsigai lambs, under European temperate conditions. Worth mentioning is that weaning rates of Dorper and White Dorper lambs during the current study are higher than estimates by Zishiri et al. (2013) for Dorper lambs born in South Africa. Although White Dorper ewes were less prolific, Csizmar et al. (2014) have shown high growth rates of the breed under Hungarian rearing conditions. Therefore he indicated the breed potential to be used as terminal sire breed in crossbreeding schemes with native populations in order to improve meat production (growth rates, heat stress tolerance and carcass quality).

Under commercial sheep production systems, the importance of fitness relates to the attrition of breeding ewes (Borg, 2007). Differences in attrition rates between Dorper genotypes and Tsigai breed were significant ($p \leq 0.05$). Genotype disparities in attrition rates could be explained by the considerable lower numbers of the Dorper and White Dorper breeds in Hungary, and as a result, decisions on voluntary culling of ewes were made only in extreme cases. In Tsigai breed the voluntary culling of ewes occurred especially based on traits such as fertility, weaning ability, age, body condition and health disorders. Information regarding the Dorper and White Dorper breeds' introduction in Hungary and these breeds census are described by Budai et al. (2013). Data on attrition rates in Tsigai ewes are consistent with estimates reported by Mekkawy et al. (2009) for commercial sheep flocks.

Further studies, with more detailed information regarding the time and reason of ewes removal from flock are needed to properly address genetic and environmental effects on ewe productivity, in order to account for their influence on ewe stayability. Phenotypic and genetic evaluation of fitness characteristics in meat sheep under a wide range of environments should be undertaken by researchers in collaboration with farmers organizations, in order to define new selection indexes.

IMPLICATIONS

Comparison of the three breeds for their reproductive performance and organic resistance under European temperate conditions were considered necessary knowledge for the sheep industry as exotic breeds' adaptation tends to be a matter of concern for the breeders. Failures in the introduction of new genotypes from divergent rearing conditions in the region are frequently being mentioned. Further research on growth performances and carcass quality of lambs under different rearing systems to effectively understand production efficiency in Dorper and White Dorper breeds would provide valuable information for the sheep sector in Europe and worldwide. This study was the first attempt to provide information on the reproductive efficiency and health traits in Dorper, White Dorper, and Tsigai breeds under temperate climate conditions found in Europe. Results suggest that South African Dorper and White Dorper sheep breeds have adapted well to the specific rearing conditions. As a result, it is therefore feasible for sheep breeders to attain increased profitability if they adopt Doper germplasm in their enterprises.

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