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Impacts of heat stress on the growth performance and meat tenderness of 2ND cross and dorper lambs (#133)

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Notes

Introduction

Heat stress (HS) is one of the greatest challenges facing the livestock industry, as increased environmental temperature compromises animal welfare and productivity during the hot summer months. To maintain homeothermy during exposure to high ambient temperatures, animals often reduce heat production by reducing feed intake [1]. However, there is genetic variation in thermotolerance among different breeds of sheep and hair sheep may have better tolerance than classic wool sheep breeds [2], which may in turn may influence their growth performance. There are limited studies comparing the growth performance and meat quality of hair type and wool type breeds of sheep when exposed to HS conditions. Therefore, this experiment was designed to compare the growth performance and meat quality attributes of hair type lambs (Dorper) and dual-purpose wool/meat type lambs (2nd cross) exposed to two weeks HS during the finishing phase.

Methods

This experiment was approved by the University of Melbourne FVAS Animal Ethics Committee (AEC ID 1714357.1). Forty-eight 4-5 months old 38 – 42 kg; 24 2nd cross; Poll Dorset X (Merino X Border Leicester), and 24 Dorper lambs were procured from 5 different breeders across south-eastern Australia. Lambs were acclimatized for 1 week in group pens and then housed in individual pens for 1 week before being relocated to metabolic cages. Lambs were fed a diet of oaten (25%), lucerne (25%) chaff and standard finisher pellets (50%) *ad libitum and* water was always available. After acclimatization, animals were exposed to thermo-neutral (TN; 18-21°C, 40-50% RH, n=12) or cyclic HS (28°C (16:00 to 08:00 h) - 40°C (08:00 to 16:00 h), 40-60% RH, n=12) for 2 weeks while housed in metabolic cages in the purpose-built climatic chambers. Respiration rate and rectal temperature were recorded three times a day (8:00, 12:00, 16:00 h). Body weight was recorded at d 0 and d 14 of HS for all lambs and daily feed intake was recorded. After slaughter, hot carcass weight was recorded, fat depth (GR) was measured over the 12th rib bone of the carcass, the loin eye area was measured, and pH was measured in the loin of lumbar/sacral junction. The *Longissimus lumborum*(LL) muscle was removed at 24 h postmortem, sliced into 120±10 g steaks, and packaged using high O_2 modified atmosphere packaging (HiOx ; 80% O_2, 20% CO_2) and then placed for 0 d, 5 d and 10 d in simulated retail display. Warner–Bratzler shear force (WBSF) and hardness were measured using a texture analyzer on each specified display day [3]. Statistical analysis was performed using IBM SPSS Statistics 19 software. Single factor general linear model procedures were undertaken followed by Tukey's honestly significant difference test for multiple comparisons (95%).

Results

HS significantly increased respiration rate and rectal temperature (P < 0.01) in both Dorper and 2nd cross lambs (Figure 1). However, Dorper lambs showed lower respiration rate and rectal temperature than the 2nd cross lambs, under both HS and TN conditions at 8:00. 12:00 and 16:00 h (P < 0.05).HS significantly (P < 0.05) decreased feed intake in 2nd Cross lambs but had no influence on Dorper lambs (P < 0.05). HS decreased body weight of both Dorper and 2nd cross lambs (P < 0.05), but the decline was greater in 2nd Cross lambs. However, when compared under TN conditions, 2nd cross lambs had higher body weight gain and feed intake (P < 0.05) (Table 2). Over all, 2nd cross lambs had higher ultimate pH than Dorper (P < 0.05) (Figure 3). There was no effect of HS or breed on GR and loin eye area of carcass and meat texture after 0 d, 5 d and 10 d display (P > 0.05 for all).

Conclusion

Compared to 2nd cross lambs, Dorper lambs are more thermotolerant and maintain lower respiration rate and rectal temperature and are thus able to maintain the feed intake and lose less body weight under HS conditions. There were no differences in lamb carcass characteristics and meat texture between 2nd cross and dorper lambs under HS condition, and the difference in ultimate pH had no impact on meat tenderness.

References

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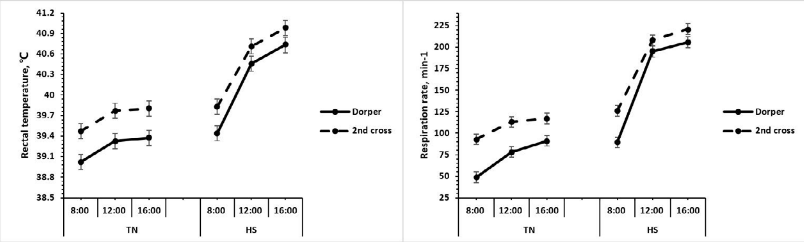

Figure 1. The effect of heat stress on respiration rate and rectal temperature of 2nd cross and Dorper lambs. Respiration rate: Treatment***, Breed***, Time***, Treatment×Breed***, Treatment×Time***, Breed×Time***, Treatment×Time×Breed N.S.; Rectal temperature: Treatment***, Breed***, Time***, Treatment×Breed N.S., Treatment×Time***, Breed×Time N.S., Treatment×Time×Breed N.S.; N.S.=No significant; *** *P*<0.01, **P*<0.05; Error bars=pooled SED

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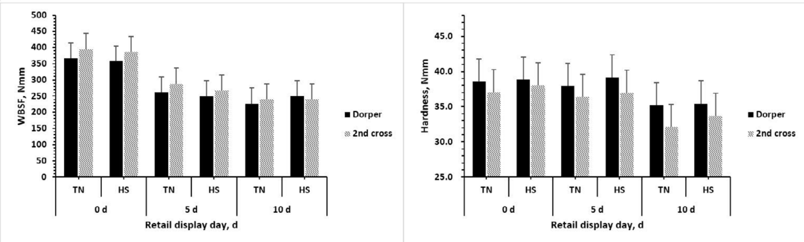

Figure 3. The effect of heat stress on meat texture of 2nd crossbred and dorper lambs *longissimus lumborum* muscle. WBSF and Hardness: Time***, Treatment, Breed, Treatment×Breed, Treatment×Time, Breed×Time and Treatment×Time×Breed N.S; N.S.=No significant; *** *P*<0.01, **P*<0.05; Error bars=pooled SED

Figure 3. The effect of heat stress on meat texture of 2nd cross and dorper lambs longissimus lumbor WBSF and Hardness: Time ***, Treatment, Breed, Treatment×Breed, Treatment×Time, Breed×Time and Treatment×Time×Breed N.S; N.S.=No significant; *** *P*<0.01, **P*<0.05; Error bars=pooled SED

Table 2. The effect of heat stress on growth performance and carcass characters of 2nd cross and dorper lambs.

	Dorper		2nd cross			Significance		
						Temperature	Breed	Temperature x breed
	TN	HS	TN	HS	SE			
Daily feed intake, kg	1.29^{a}	1.29^{a}	1.39^{b}	1.23^{a}	0.04	*	N.S.	*
Average daily gain, g	5.95^{b}	-50.6^{ab}	101^{c}	-92.3^{a}	37.2	***	N.S.	N.S.
Hot Carcass weight, kg	21.6^{ab}	21.5^{a}	23.3^{b}	22.7^{b}	0.59	N.S.	*	N.S.
GR score	3.25	3.17	2.83	2.83	0.22	N.S.	N.S.	N.S.
Loin eye area, cm^2	14.0	13.4	13.3	14.6	0.65	N.S.	N.S.	N.S.
Ultimate pH_{24h}	5.54^{a}	5.60^{b}	5.60^{b}	5.63^{c}	0.02	N.S.	*	N.S.

N.S.=No significant; *** *P*<0.01, **P*<0.05; $^{a-c}$ Means with different superscripts differ significantly of rows (*P*<0.05).

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