

Association of wool growth with rumen function in sheep

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It has been reported that sheep divergently selected for (F+) or against (F-) wool growth differ in feed utilization efficiency. F+ sheep have a higher rumen microbial protein outflow (Khan, 1996) and faster rumen kinetics (Smuts et al., 1995) than F- animals. Our hypothesis was that the differences in rumen function observed in F+ and F- sheep exist in animals with different estimated breeding values (EBVs) for clean fleece weight.

Eighteen 33-month-old Merino wethers (liveweight, 57.2 ± 8.3 kg) were fed at two levels of intake (1.0× and 1.5× ME requirement for maintenance) in two seven-week periods in a crossover design. Two wool genotypes (low and high) were evaluated. The average clean fleece weight EBVs for the low and high wool genotypes were 3.4% and 25.9%, respectively. Animals were offered oaten/lucerne chaff (14.5% crude protein, 9.1 MJ ME per kg DM) daily. Clean wool growth rate was measured on the mid-side of the sheep using the patch technique.

At the end of each measurement period, 4 h after feeding the animals, filtered rumen fluid samples were collected using an oesophageal tube. Samples were analysed for pH and concentrations of volatile fatty acids and ammonia. Rumen microbial protein supply was estimated from the concentration of urinary allantoin. Methane production was measured four times over periods of 22 h in open-circuit respiration chambers. Reticulo-rumen volume was estimated using computed tomography.

There were no differences in fermentation and digestion patterns between genotypes within the same level of intake (Table 1). Clean wool growth was the only trait affected ($P < 0.05$) by wool genotype. Higher DM intake was associated with lower DM digestibility, rumen ammonia concentration and methane yield but greater levels of microbial protein outflow and yield, reticulo-rumen volume and methane production. However, level of intake did not affect volatile fatty acid concentration

Table 1. Effect of wool genotype (WG), level of intake (LI) and their interaction (WG × LI) on rumen function.

	Wool genotype		Level of intake		WG × LI
	High	Low	1.0 × MEm ¹	1.5 × MEm	P
DM intake (g/d)	1062 ± 4	1059 ± 5	857 ± 5 ^b	1264 ± 4 ^a	ns
Liveweight gain (g/d)	41 ± 7	38 ± 8	5 ± 7 ^b	74 ± 7 ^a	ns
Clean wool growth (µg/d/cm ²)	946 ± 53 ^a	791 ± 62 ^b	722 ± 57 ^b	1015 ± 57 ^a	ns
DM digestibility (%)	61.4 ± 0.3	61.5 ± 0.4	62.7 ± 0.4 ^a	60.2 ± 0.3 ^b	ns
Rumen pH	6.4 ± 0.04	6.4 ± 0.04	6.4 ± 0.04	6.4 ± 0.04	ns
Rumen ammonia (µg/mL)	222 ± 11	217 ± 12	236 ± 12 ^a	203 ± 12 ^b	ns
MP outflow (g/d)	59.5 ± 2.7	64.6 ± 2.5	46.3 ± 2.6 ^b	77.8 ± 2.6 ^a	ns
MP yield (g/kg DM intake)	55.2 ± 2.3	60.7 ± 2.2	54.4 ± 2.3 ^b	61.5 ± 2.2 ^a	ns
Total VFA (mmol/L)	84.4 ± 1.9	82.9 ± 2.2	83.6 ± 2.0	83.8 ± 2.0	ns
Methane production (g/d)	32.3 ± 0.7	31.6 ± 0.8	28.3 ± 0.8 ^b	35.6 ± 0.8 ^a	ns
Methane yield (g/kg DM intake)	20.8 ± 0.3	20.3 ± 0.3	22.0 ± 0.3 ^a	19.2 ± 0.3 ^b	ns
Reticulo-rumen volume (cm ³)	7712 ± 282	7447 ± 315	7310 ± 223 ^b	7849 ± 223 ^a	ns

¹MEm = metabolizable energy for maintenance; ^{ab}Means within rows and factors (wool genotype and level of intake) with differing letters are significantly different ($P < 0.05$). MP, microbial protein; VFA, volatile fatty acid.

or pH.

The differences in rumen fermentation patterns and feed utilization efficiency observed in F+ and F- sheep were not observed in sheep differing in EBV for clean fleece weight despite a difference in wool growth of 20%. This indicates that different genetic selection approaches for wool growth may have diverse consequences on feed digestion and fermentation.

Increases in the level of intake could enhance microbial protein supply to the host, reduce methane yield and increase liveweight gain and wool growth, indicating that level of intake could be used as a tool for modifying rumen function.

Kahn LP (1996) Differences between Merino selection lines in microbial yield from the rumen and utilisation of protein for wool growth. PhD Thesis, University of New England, Armidale, NSW 2351, Australia.

Smuts M, Meissner HH, Cronje PB (1995) Retention time of digesta in the rumen: its repeatability and relationship with wool production of Merino rams. *Journal of Animal Science* 73, 206–210.