Intake, total-tract digestibility and methane emission of Texel and Blackbelly sheep fed C4 and C3 grasses tested simultaneously in a temperate and a tropical area

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Introduction Enteric methane (CH_4) emission from forages may be higher for tropical forages than for temperate ones (Archimède *et al.*, 2011). One possible reason is the difference in plant structure associated to the C4 or C3 metabolism of tropical and temperate plants, respectively. Animal breed and environment could also be other explanatory factors (Martin *et al.*, 2010). In order to better know the origin of these differences in CH_4 emission, a sheep breed from the Caribbean and another developed in temperate conditions were used in two parallel trials in a tropical and a temperate area.

Material and methods Two 4 x 4 Latin squares have been carried out simultaneously in two sites (France, temperate, and West Indies, tropical) with two sheep breeds (Texel (T), temperate origin, and Blackbelly (B), tropical origin) and four hays from natural grasses (two C3 grown in France and two C4 grown in West Indies). High (H) and low quality (L) hays were tested within each type of grass; NDF and crude protein content in % dry matter (DM) of C3-H, C3-L, C4-H and C4-L were 58.6 and 13.4; 62.3 and 8.3; 74.3 and 12.0; 74.2 and 6.9, respectively. Sheep body weight (BW) was 46.9 and 59.2 for B and T in France and 48.2 and 40.3 kg for B and T in West Indies. DM voluntary intake, organic matter (OM) total-tract digestibility and enteric CH_4 emission (using the SF_6 method) were measured. Statistical analyses were performed using the mixed procedure of SAS with period, site, hay, breed, and the interactions between the 3 latter factors as fixed effects and animal as random effect. Statistical differences were declared significant when $P \leq 0.05$.

Results DM intake (g/kg BW/d) was similar in the two sites. Independently of site, C4 grass in particular C4-L had lower DM intake than C3 grass. A breed×site interaction was also observed with intake higher in B compared to T in West Indies whereas the opposite was registered in France. OM total-tract digestibility was significantly higher in West Indies compared to France (62.3 vs 59.4; P=0.0044). In contrast, no breed effect or breed×site interaction were observed on digestibility. H grass digestibility was higher than that of L grass The geographic site did not affect CH_4 emissions expressed per kg DM intake or per kg digestible OM intake (DOMI) but a breed×site interaction was registered with lower emission for B compared to T in West Indies whereas the opposite was registered in France. In France, CH_4 emissions were significantly higher with C4-H compared with C4-L diet.

Table 1 Voluntary dry matter intake (DMI), organic matter digestibility and methane emission per kg DMI and kg digestible organic matter intake (DOMI) of two sheep breeds fed four different forages in two simultaneous trials in France and the West Indies

Forage	C3-H		C3-L		C4-H		C4-L			
Breed	B	T	B	T	B	T	B	T	s.e.m.	P and effect of factors
Dry matter intake , g/kg BW/d										
France	21.8	28.9	25.2	26.3	17.0	16.8	15.1	12.9	1.87	<0.001 (Forage, breed x site)
West Indies	22.8	25.8	23.7	21.9	22.8	14.8	18.7	13.8		
Organic matter digestibility, %										
France	68.8	64.6	57.4	56.6	62.9	62.3	52.8	49.6	1.97	<0.001 (Forage, site)
West Indies	66.6	65.2	58.5	55.3	67.0	67.4	56.6	62.1		
Enteric methane, g/kg DMI										
France	23.9	16.6	19.0	15.6	24.0	20.1	16.9	13.8	2.63	0.001 (Forage, breed x site)
West Indies	12.2	18.9	15.8	18.0	18.4	27.1	18.1	27.0		
Enteric methane, g/kg DOMI										
France	39.1	29.2	35.8	29.6	42.8	35.3	33.8	30.5	4.79	0.01 (Forage, breed x site)
West Indies	20.5	32.5	29.3	35.3	29.8	44.2	34.1	47.3		

Conclusions In the West Indies DM intake of Blackbelly was higher than for Texel breed probably because they are adapted to warm climate and consequently they have a better thermoregulation. This trial confirms that CH4 emissions were generally lower for C3 than for C4 forages but the differences are linked to the grass quality.

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References

Archimède, H., Eugène, M., Marie-Magdeleine, C., Boval, M., Martin, C., Morgavi, D.P., Lecomte, P., and Doreau, M. 2011. Animal Feed Science and Technology. 166-167, 59-64.
Martin, C., Morgavi, D.P., and Doreau, M., 2010. Animal. 4, 351–365.

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