Results

Treatment effects are shown in Table 1. As compared to control treatment, supplementation with CM increased digestible OM intake, duodenal flux of α-amino N and N retention in wethers fed a tropical grass based-diet. Among supplemented animals both digestible OM intake and N retention increased linearly whereas duodenal flux of α-amino N tended to increase ($P = 0.07$) with increased levels of CM supplementation. Microbial N entering the small intestine was similar for all treatments.

Table 1 *Effects of canola meal supplementation on digestible organic matter intake (DOMI), duodenal flux of microbial N and α-amino N, and N retention in wethers fed a Sudangrass based-diet*

	(g/kg BW canola meal)					*P*-value*	
Item	0 (Control)	5	10	15	s.e.m	C vs. S	S
			(g/d)				
DOMI†	344	389	502	565	35.4†	<0.001	0.002
Microbial N¥	3.03	4.08	4.20	4.80	1,99¥	n.s.	n.s.
α-amino N¥	3.67	6.54	8.07	9.75	0.81¥	<0.001	n.s.
N retention¥	3.48	7.49	11.09	16.75	1.36†	<0.001	<0.001

†$n = 8$ per treatment; ¥ $n = 4$ per treatment; * = Probability of type I Error: C vs. S = contrast between control and supplementation and S = linear effect of supplementation levels.

Conclusions

Supplementation with canola meal improves energy and amino acids supply in wethers fed tropical forage based diets.

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Intake and digestibility of fresh grass fed to sheep indoors or at pasture, at various stages of regrowth and levels of feeding

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Introduction

Under tropical condition, fresh forage, used *in situ* at pasture or cut and distributed indoors, is the most common feed resource for ruminants. Intake and digestibility are the two main parameters known to control ruminant production from such resource. Due to the lack of accuracy of the measurement methods for such parameters at pasture, the fundamentals of animal feeding are often based on the extrapolation of results obtained indoors. However, although most of the factors known to affect intake and digestibility of animals fed indoors may also affect grazing animals, some factors like the selective behaviour implemented by grazing animals, appear to be specific to the grazed forage (Minson, 1990). To our knowledge (Fanchone *et al.*, 2010), studies that have attempted to compare nutrition indoors and at pasture are

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seldom based on the same forage offered. The aim of this work was to evaluate the differences in organic matter intake (OMI) and organic matter digestibility (OMD) between animals fed with the same forage indoors and at pasture. To test the constancy of these differences in various situations, this comparison was lead at two different stages of regrowth (variation of grass quality) and at two levels of feeding (variation of the quantity of grass offered).

Materials and Methods

A data set was made from 3 digestibility trials carried out from 2006 to 2008. All trials were conducted at the animal experimental station at the "Institut National de la Recherche Agronomique" (INRA) in Guadeloupe. The main effect tested through the different trials was the way of feeding animals (indoors or at pasture), coupled with the level of feeding (Experiment 1) or the stage of regrowth of the grass (Experiment 2 and 3). In all trials, *in vivo* organic matter digestibility (OMD) was measured indoors by total collection of faeces. In addition, OMD was estimated indoors and at pasture using the faecal crude protein (CPf) method (OMD_{CPf}). *In vivo* organic matter intake (OMI) was then estimated from faecal organic matter output, and OMD estimated using the CPf method (OMI_{CPf}). Feeding behaviour was determined by observation of the current activity (eating, ruminating or idling) of each rams on one day during 24 h continuously. Chewing was defined as eating plus ruminating. The eating, ruminating, and chewing index (min/g OMI) were calculated by dividing the time spent eating, ruminating or chewing, by the OMI_{CPf}. On animals fitted with rumen cannulae, a sample of approximately 200 g of rumen content was collected at 0, 3, 6, and 12 h after the morning meal to determine rumen pH and rumen ammonia (NH_3). Two rumen empties were manually carried out 3 h and 24 h after the morning meal for each ram fitted with a rumen cannulae to determine rumen fill. In experiment 1, treatments were two ways of feeding (indoors or at pasture) and two levels of herbage allowance (low or high). Sixteen adult Martinik rams (52.4 $\pm$ 0.25 kg), including eight fitted with rumen cannulae, were used according to a 4 $\times$ 4 Latin Square design. Rams were fed with a 28-d regrowth Pangola (Digitaria decumbens) grass diet during four successive 28 days experimental periods. In experiment 2, ten adult Martinik rams (50.5 $\pm$ 0.91 kg), including four fitted with rumen cannulae, consumed indoors or at pasture a 21 days regrowth Pangola diet during two successive measurement periods, according to a 2 $\times$ 2 Latin Square designs. In experiment 3, ten other Martinik rams (45.5 $\pm$ 0.94 kg), also including four fitted with rumen cannulae, consumed indoors or at pasture, a 35 days regrowth Pangola diet during two successive measurement periods, according to a 2 $\times$ 2 Latin Square designs. Data were analysed using the MIXED procedure of SAS (2000; SAS Inst. Inc., Cary, NC), using the REPEATED statement within this procedure for samples collected at fixed time after the feeding (i.e., ruminal pH and NH_3).

Results

Indoors, correlations of 0.61 and 0.79 were found between *in vivo* OMD and OMD_{CPf} ($P < 0.001$) and between *in vivo* OMI and OMI_{CPf} ($P < 0.001$), respectively. OMD_{CPf} at pasture was 1.03, 1.02 and 1.03 that registered indoors ($P < 0.05$) in experiment 1, 2 and 3, respectively. At the same time, OMI_{CPf} indoors was 1.24, and 1.16 that registered at pasture ($P < 0.01$) in experiment 1, and 3 respectively. Resulting $DOMI_{CPf}$ indoors was 1.20 and 1.15 that registered at pasture ($P < 0.05$) compared to at pasture in experiment 1, and 3, respectively. In experiment 2, only a numerical differences were found between OMI_{CPf} ($P = 0.11$) and $DOMI_{CPf}$ ($P = 0.22$) indoors and at pasture.

Discussion

The greater OMD_{CPf} measured at pasture, whatever the experiment, was related to the ability of grazing animals to select a better quality forage than that offered. Parameters such as the ammonia concentration in the rumen which was greater at pasture and the chewing index which was greater indoors, illustrate the greater selective behaviour implemented by rams at pasture. The differences in OMI_{CPf} in turn were linked to differences in prehensibility of forage between the two feeding systems. Indeed for most experiments, OMI_{CPf} was greater indoors compared to at pasture, while, the eating index (min/g OMI_{CPf}) is greater at pasture compared to indoors. Time spent eating includes time for searching and time really devoted for prehension. Hence, the selective grazing implemented by the animals at pasture, which was responsible for the greater OMD_{CPf}, may have increased the time spent searching to the detriment of the time taken for prehension. The bite mass at pasture may have been affected by the total bulk density of the grass which was 6 to 4 times lower at pasture than indoors. Therefore, the difference in forage density between the two feeding systems (mown and packed in the trough, or growing in situ at pasture), coupled with the reduced time devoted strictly to eating at pasture, may explain the fall in OMI_{CPf} at pasture compared to indoors. Others parameters known to affect OMI at pasture, i.e., availability and selection of leaves (Minson 1990) have to be studied to further explain this difference.

Conclusion

These studies show that feeding differences exist between animals fed indoors and at pasture with the same forage. Care has to be taken when extrapolating fundamentals of animal feeding from results obtained indoors to grazing conditions.

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