Forage intake and nitrogen retention in wethers fed ryegrass haylage supplemented with maize silage

João GR Almeida [A], Henrique MN Ribeiro Filho [A], Ederson A de Andrade [A], Gabriela C Guzatti [A], Paulo G Duchini [A], Gutierri T Raupp [A] Fabiana R Ramos [A] and Rémy Delagarde [B]

[A] Universidade do Estado de Santa Catarina, Brazil, www.cav.udesc.br
[B] Institut National de La Recherche Agronomique (INRA), France, www.rennes.inra.fr
Contact Email: a2hrf@udesc.br

Keywords: *Lolium multiflorium* Lam., substitution rate, *Zea mays*.

Introduction

Many decision support tools have been developed to predict herbage intake with herbivore ruminants indoors (Faverdin 1992) or at grazing, both using short-term (Baumont *et al.* 2004) or daily scale input variables (Heard *et al.* 2004; Delagarde *et al.* 2011). However, the ingestive and digestive interactions when diets with more than one type of forage are used have not been sufficiently studied. The aim of this study was to assess the effects of maize silage supplementation to wethers receiving ryegrass haylage on OM intake, OM digestibility, microbial protein synthesis and N retention.

Methods

The four treatments consisted of ryegrass haylage (RH, *Lolium multiflorum* Lam.) offered *ad libitum* without supplementation (0MS) or supplemented with maize silage (MS) + soybean meal (SM) (9:1 (DM basis)) in proportion of 5 (5MS), 10 (10MS) and 15 g (15MS) of DM/kg of live weight (LW). Eight castrated male sheep (27.6 ± 3.5 kg liveweight) were assigned in a 4 × 4 Latin square design with four periods of 17 days, with 12 days of adaptation and 5 days of measurements. Animals were fed twice a day (08:00 h and 14:00 h), in amounts to have at least 20% refusals of RH daily. Treatments 5MS, 10MS and 15MS, received MS at 08:00h and RH at 14:00h. Immediately before distribution of RH, forage refused was weighed. Chemical composition of ryegrass haylage was 410 g DM/kg of fresh weight and 149 and 544 g/kg DM of CP and NDF, respectively. The mixed MS+SM presented 348 g DM/kg of fresh and 129 and 394 g/kg DM of CP and NDF, respectively.

Feeds offered and refused, as well as faeces, were weighed daily and sub-sampled from days 13 to 17 of each experimental period. All samples were oven-dried at 60°C for at least 72 h and ground through a 1 mm sieve for subsequent chemical analysis. Urine was collected daily during the measurement period in buckets containing 100 ml of 3.6 M of sulphuric acid. The volume of urine was measured and a sample of 10 ml/l was diluted in water in 200 mL volumetric flask and stored frozen (–20°C) until analysis. In urine samples the total purine derivatives were determined and microbial protein synthesis estimate according to Chen and Gomes (1992).

Data were submitted to variance analysis using the procedure MIXED of Statistical Analysis Systems (SAS, 1996) using a model that included the random effects of animal and periods, and the fixed effects of silage inclusion. Because of high refusals of MS in animals receiving 15 g/kg LW of maize silage, differences between 5g/kg LW of maize silage and an average of 10 and 15 g/kg LW of maize silage were analyzed by orthogonal contrasts. The same kind of analysis was performed to compare treatments without supplement-ation and the supplemented ones.

Results

The total OM intake was not affected by treatments, but ryegrass OM intake decreased ($P < 0.01$), on average, by 178 g/d in animals receiving maize silage compared with animals without supplementation (Table 1). The digestible OM, N intake, microbial protein synthesis and N retention were lower ($P < 0.05$) in animals receiving 5 g/kg LW of maize silage compared with animals receiving 10 or 15 g/kg LW of maize silage. Efficiency of rumen microbial protein synthesis was not affected by maize silage supplementation. The substitution rate was 1.45 in animals receiving 5 g/kg LW of maize silage and on average 0.87 for animals receiving 10 or 15 g/kg LW of maize silage.

The similarity in total and ryegrass OM intake between animals receiving 10 or 15 g/kg LW of maize silage highlights a high-level of refusals of maize silage in treatment 15MS. On the other hand, the high-level of substitution rate in treatment 5MS was unexpected, and due to very low RH intake. Both results can be associated with the amount of maize silage distributed during a first meal. According to Jarrige *et al.* (1995) daily forage intake is closely related to the amount eaten during main meals and 60 to 80% of daily intake is eaten during two main meals. Thus, it is probable that animals receiving 5 g/kg LW of maize silage did not compensate for the low level of DM received in the first meal during the second meal. Otherwise, animals receiving 15 g/kg LW of maize silage did not have time to eat more than 60% of the

Table 1. Organic matter (OM) intake, digestibility, rumen microbial N and efficiency of rumen microbial protein synthesis in weathers fed ryegrass haylage (*Lolium multiflorum* Lam) supplemented with levels of a mixture (9:1 of DM) of maize silage + soybean meal

Parameter	Maize silage + Soybean meal (g/kg LW)				rsd†	Orthogonal contrasts (*P*- value)	
	0	5	10	15		0 × 5;10;15	5 × 10;15
Intake (g/day)							
Ryegrass OM	677	507	495	494	122.7	0.005	0.829
Total OM	677	624	699	710	97	0.977	0.107
Digestible OM	475	429	506	507	70.5	0.851	0.047
Nitrogen	18.6	16.5	19	19.3	2.35	0.745	0.044
OM digestibility	0.7	0.68	0.69	0.7	0.014	0.447	0.15
N retention (g/day)	11	9.7	11.4	11.3	1.29	0.739	0.033
Microbial N (g/day)	4.2	4.1	4.8	5.4	0.93	0.22	0.052
EMPS§	8.9	9.9	10.6	11	2.08	0.124	0.406

† Residual standard deviation. § Efficiency of rumen microbial protein synthesis (EMPS = microbial N (g/day)/digestible OM intake (kg/day)).

maize silage offered. Finally, the lower digestible OM and N intake in treatment 5MS reduced availability of N and fermentable OM in the rumen, which was the factor limiting bacterial growth and N retention to animals receiving low level of supplementation.

Conclusion

High levels of maize silage-soybean meal supplementation did not increase OM, digestible or nitrogen intake on wethers fed on ryegrass haylage, nor affect ruminal nitrogen metabolism. Low levels of maize silage supplement distributed during a single meal to wethers can negatively affect digestible OM intake and N retention.

References

Baumont R, Cohen-Salmon D, Prache S, Sauvant D (2004) A mechanistic model of intake and grazing behaviour in sheep integrating sward architecture and animal decisions. *Animal Feed Science and Technology* **112**, 5–28.

Chen XB, Gomes, MJ (1995) Estimation of microbial protein supply to sheep and cattle based on urinary excretion of purine derivatives – An overview of the technical details. International Feed Resources Unit Rowett Research Institute, Bucksburn Aberdeen.

Delagarde R, Faverdin P, Baratte C, Peryaud JL (2011) GrazeIn: a model of herbage intake and milk production for grazing dairy cows. 2. Prediction of intake under rotational and continuously stocked grazing management. *Grass and Forage Science* **66**, 45–60.

Faverdin P (1992) Alimentation des vaches laitières: comparaison des différentes méthodes de prédiction des quantités ingérées. *INRA Productions Animales* **5**, 271–282.

Heard JW, Cohen DC, Doyle PT, Wales WJ, Stockdale CR (2004) Diet-Check – a tactical decision support tool for feeding decisions with grazing dairy cows. *Animal Feed Science and Technology* **112**, 177–194.

Statistical Analysis Systems Institute (1996). 'Language guide' (Cary: North Carolina)

Jarrige R, Dulphy J-P, Faverdin P, Baumont R, Demarquilly C (1995) Activités d´ingestion et de rumination. In : 'Nutrition des ruminants domestiques: ingestion et digestion' (Jarrige R, Ruckebush Y, Demarquilly, C, Farce M-H and Journet M, eds.) pp. 123-181. (INRA: Paris)