Peer-reviewed paper: 10th World Conference on Animal Production

Rate of intake in wethers fed a temperate pasture with different feeding schedules and supplemented or not with additives

A. Pérez-Ruchel[1#], J.L. Repetto[2], M. Michelini[1], L. Pérez[1], G. Soldini[1] and C. Cajarville[1]
[1] Departamento de Nutrición, [2]Departamento de Bovinos, Facultad de Veterinaria, UdelaR. Lasplaces 1550, Montevideo, Uruguay

Abstract

The effect of the feeding schedule and the use of additives on the intake and its rate were studied on animals consuming a temperate pasture. Twenty four wethers (47.8 ± 6.4 kg BW), housed in metabolism cages, were fed a fresh pasture (80% *Lotus corniculatus*) and assigned to four groups. Group AD had forage available all day; group 1D was fed for 6 h/day; group 1D&B was fed 6 h/day plus 2% DM intake level of buffer (75% $NaHCO_3$-25% MgO) and group 1D&S was fed 6 h/day plus 6.2 x 10^9 CFU/animal/day of *Saccharomyces cerevisiae.* Daily intake and its rate were measured weighing the amount offered and refused every one hour for six hours. Orthogonal contrasts were performed on data to study the effect of feeding schedule, the use of additives and the type of additive used. There were no differences in g of DM ingested/kg $BW^{0.75}$/day (mean value: 52.8). Groups fed 6 h/day showed a higher rate of intake for every hour studied (i.e. hour 2: AD: 5.9 *vs.* 6 h/day: 7.2). Within groups fed 6 h/day plus the buffer supplemented one presented the highest cumulative intake, at 20.9 g DMi/kg BW.

Keywords: Temperate pasture, feeding schedule, intake, additives
[#] Corresponding author. E-mail: anapevet@gmail.com

Introduction

In Uruguay high quality forages are extensively used for ruminants under grazing conditions. In semi-intensive production systems (i.e. dairy production) pasture grazed represents over 70% of the total diet, and often the daily time of access is restricted. This restriction is done for several reasons, such as to improve pasture management, to take care of the animals (i.e. protect from predators) or in order to control feed intake by the animal.

Subclinical ruminal acidosis causes a reduction of feed intake and nutrient absorption as well as a depression on animal performance (Owens *et al*., 1998). It is well known that restricted feeding time followed by high rates of intake of high grain diets may induce subclinical ruminal acidosis in dairy and beef cattle (Krause & Oetzel, 2006). However, there is limited information about ruminal acidosis under grazing conditions. A ruminal pH of below 6.2 was observed by Cajarville *et al.* (2006a; b) for several hours in animals fed high quality pastures. These low pH values were related to high rates of intake due to a short period of access to the pasture.

The addition of buffer substances to ruminant diets helps to stabilize ruminal pH and prevent a depression in ruminal pH and its consequences (Owens *et al*., 1998; NRC, 2001). Other additives are probiotics, live micoorganisms that modify ruminal microflora, improving ruminal fermentation. Probiotics are also recommended whenever there is a risk of ruminal dysfunction to improve anaerobiosis, stabilize pH and supply nutrients to microbes in their micro environment (Newbold *et al*., 1993; Giger-Reverdin *et al*., 2004). Although there are several studies on the use of additives in mixed rations (Thivierge *et al*., 1998; Khorasani & Kennelly, 2001) there are few reports about their use in pasture-based diets.

Feeding behaviour of ruminants fed indoors or on grazing has been studied extensively (Jarrige *et al*., 1995; Ungar, 1996). Dry matter feed intake is the most important factor determining the animal performance (Waldo, 1986). Regulation of feed intake combines short-term control of feeding behaviour related to the body homeostatic regulation, and long-term control that depends on nutritional requirements and body reserves (Faverdin *et al*., 1995). Feed factors act mainly on the short-term control. It is necessary to know how the restriction in time of access to food affects the feeding behaviour and the intake of animals.

The aim of this work was to study the effect of the feeding schedule, the buffer or probiotic addition, on the daily intake and rate of intake by wethers fed only forage.

Peer-reviewed paper: 10th World Conference on Animal Production

Materials and Methods

The study was performed at the Experimental Farm of the Facultad de Veterinaria-UdelaR, Uruguay (San José Department, 34º South and 55º West). Twenty four wethers with an average body weight of 47.8 ± 6.4 kg, individually housed in metabolism cages, were fed fresh forage from a pasture (80% *Lotus corniculatus*, initial availability at 2 065 kg DM/ha), in a vegetative stage. The pasture was cut at 7:00 at a 5 cm height with a disk mower. Forage was offered to the animals immediately after cutting. The chemical composition of the pasture was 260 g dry matter (DM)/kg, 910 g organic matter (OM)/kg DM, 140 g crude protein (CP)/kg DM and 250 g acid detergent fibre (ADF)/kg DM. Animals were blocked by weight and assigned to four treatment groups. Group AD received forage throughout the day; group 1D forage 6 h/day; group 1D&B 6 h of forage/day plus a buffer substance; group 1D&S 6 h of forage/day plus a probiotic. The buffer (75% sodium bicarbonate and 25% magnesium oxide) was provided at 2% of total DM ingested. The probiotic was *Saccharomyces cerevisiae*, provided at a dosage of 6.2 x 10^9 CFU (colony forming units)/animal/day. The buffer and probiotics were orally administered to the animals at zero hour, immediately before the meal was offered. The experiment consisted of a 21-day diet adaptation phase and a 7-day measurement phase. During the measurement phase total daily intake was determined by weighing the amount of feed offered and the orts. During the last three days of the measurement period, intake rate was also determined by weighing the amount offered and orts every one hour for six hours. Samples of feed and orts were dried at 60 ºC for 48 h to determine DM content.

Data were analyzed by orthogonal contrasts to study the effect of feeding schedule (AD *vs.* 1D + 1D&B + 1D&S), the use of additives (1D *vs*. 1D&B + 1D&S) and the type of additive (1D&B *vs*. 1D&S). A mixed procedure was performed to evaluate the cumulative intake from the beginning of the meal to 6 h later. The model included treatment (t), hour (h), and t x h effects (SAS®).

Results and Discussion

In Table 1 daily DM intake (DMi) of each group of wethers is presented. Total daily intake was according to expectation for the type of animals (NRC, 1985), ranging from 48.8 to 59.4 g DMi/kg $BW^{0.75}$.

Dry matter intake (g DMi/d) was highest for animals fed throughout the day. No differences were observed when DMi was expressed as g DMi/d/kgBW or $gDMi/d/kgBW^{0.75}$. The use of additives and the type of additive did not affect daily DMi. Other authors (Kawas *et al*., 2007) working with lambs fed high grain diets, found an increase in daily feed intake when animals were supplemented with buffers.

Table 1 Daily intake and intake rate in wethers fed a fresh forage from a pasture offered all day (AD), six hours per day (1D), and supplemented with additives (buffers (1D&B) or probiotic (1D&S))

	AD	1D	1D&B	1D&S	s.e.	P: Feeding schedule [a]	P: Use of additives [b]	P: Type of additive [c]
Intake								
gDMi/d	1149	872	956	854	102	0.047	ns	ns
gDMi/d/kgBW	22.1	18.7	20.9	18.9	1.89	ns	ns	ns
$gDMi/d/kgBW^{0.75}$	59.4	48.8	54.2	48.9	5.14	ns	ns	ns
Rate of intake								
gDMi/kgBW h1	4.53	4.97	5.57	5.38	0.29	0.034	ns	ns
gDMi/kgBW h2	2.20	2.84	3.18	2.27	0.23	0.047	ns	0.013
gDMi/kgBW h3	1.91	2.70	3.07	2.87	0.19	<0.001	ns	ns
gDMi/kgBW h4	1.77	2.70	3.10	2.72	0.28	0.005	ns	ns
gDMi/kgBW h5	1.91	2.77	3.19	2.92	0.17	<0.001	ns	ns
gDMi/kgBW h6	1.42	2.74	2.76	2.73	0.21	<0.001	ns	Ns

gDMi/d: g dry matter intake per day; BW - body weight; gDMi/kgBW h1-h6 - g dry matter intake/BW/hour; s.e. - standard error of the means; [a] AD *vs.* 1D + 1D&B + 1D&S; [b] 1D *vs.* 1D&B + 1D&S; [c] 1D&B *vs.* 1D&S; ns: non significant (P >0.05).

The rate of intake, for all groups was higher in the first hour. Baumont *et al*. (2000) suggested that the initial rate of intake represents the animal motivation to eat and after it the rate of intake would decrease until the satiation state.

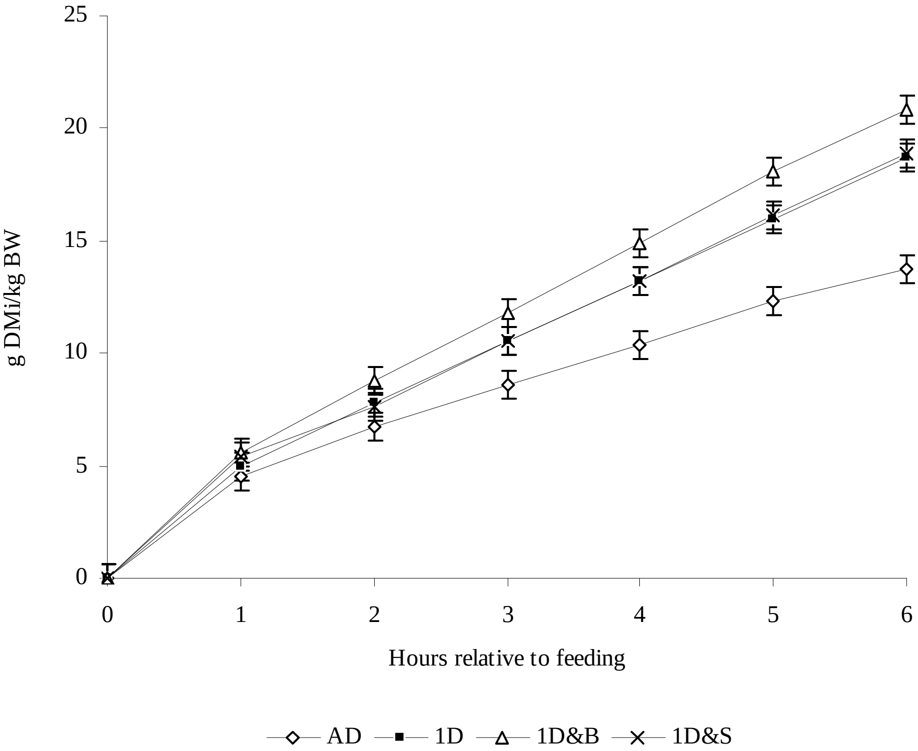

Figure 1 Cumulative intake during six hours (g DM intake per kg BW) in wethers fed fresh forage offered all day (AD) or six hours per day (1D), supplemented or not with additives (buffers (1D&B) or probiotics (1D&S)), (means ± s.e.).

Groups fed six h/day showed a higher rate of intake for every hour studied which could be a behavioural adaptation to the feeding regimen. Rate of intake, especially at the beginning of the meal, would be a key factor in the voluntary forage intake (Moseley & Antuna-Manendez, 1989).This could explain the level of intake observed in restricted animals. It would be interesting to know if this type of compensation is possible under restricted grazing conditions. These data are in agreement with other authors working with grazing cows where feeding time was restricted (Chilibroste *et al*., 2005; Pérez-Ramírez *et al.*, 2008).

In the present study, the rate of intake did not differ among groups fed 6 h/day. The exception was at hour two, when buffer supplementation led to a higher rate of intake. This could be due to an action of the buffer, by improving stabilization of the rumen environment. However, the rumen pH was on average 6.77, and did not differ between treatments (P >0.05, data not published).

Figure 1 presents cumulative intake for the first six hours related to the beginning of the meal. Dry matter ingested increased during the first six hours relative to feeding for all groups, but it was different between them (at hour six, cumulative intake in group AD was 13.7; in group 1D: 18.7; in group 1D&B, 20.9 g and in group 1D&S, 18.9 gDMi/kg BW, P <0.001). Animals supplemented with buffers had the highest cumulative intake (P <0.05) probably as a consequence of a higher rate of intake at hour two. Although the animals fed throughout the day showed the highest daily DM intake, they had the lowest cumulative intake during the first six hours.

Conclusions

In this study wethers fed six hours per day showed a lower daily DM intake but a higher rate of intake for every hour studied. Animals fed six hours per day plus a buffer had the highest cumulative intake.

Acknowledgements

The authors thank PDT-DICyT (78/12 project and S/PSP/02/48 scholarship) for the financial support, CODENOR S.A for providing the materials and Sebastián Brambillasca for the English revision.

References

Baumont, R., Prache, S., Meuret, M. & Morand-Fehr, P., 2000. How forage characteristics influence behaviour and intake in small ruminants: A review. Livest. Prod. Sci. 64, 15-28.

Cajarville, C., Pérez, A., Aguerre, M., Britos, A. & Repetto, J.L., 2006a. Effect of the timing of cut on ruminal environment of lambs consuming temperate pastures. J. Anim. Sci. 84, Suppl. 1, 103.

Cajarville, C., Aguerre, M., Britos, A., Tebot, I., Pérez, A., Elizondo, V. & Repetto, J.L., 2006b. Effect of feeding frequency of fresh forage on ruminal pH: data review. Proc. of the XIV Int. Symp.: Lameness in Ruminant: 96-97.

Chilibroste, P., Gibb, M., & Tamminga, S., 2005. Pasture characteristics and animal performance. In: Quantitative Aspects of Ruminant Digestion and Metabolism. Ed. Dijkstra. pp. 681.

Faverdin, P., Baumont, R. & Ingvartsen, K.L., 1995. Control and prediction of feed intake in ruminants. In: Recent Developments in the Nutrition of Herbivores. Proc. IVth Int. Symp. Nutrition of Herbivores. Eds Journet, M., Grenet, E., Farce, M.H., Thériez, M. & Demarquilly, C., Paris, 11-15 September 1995. INRA Editions, Paris. pp. 95-120.

Giger-Reverdin, S., Sauvant, D., Tessier, J., Bertin, G. & Morand-Fehr, P., 2004. Effect of live yeast culture supplementation on rumen fermentation in lactating dairy goats. S. Af. J. Anim. Sci. 34, 59-61.

Jarrige, R., Dulphy, J.P., Faverdin, P., Baumont, R. & Demarquilly, C., 1995. Ingestion and digestion Activities in ruminats. In: Domestic Nutrition of Ruminants. Eds Jarrige, R., Ruckebusch, Y., Demarquilly, C., Farce, M.H. & Journet, M., INRA Editions, Paris. Pp. 123-181. (in French).

Kawas, J.R., García-Castillo, R., Fimbres-Durazo, H., Garza-Cazares, F., Hernández-Vidal, J.F.G., Olivares-Sáenz, E. & Lu, C.D., 2007. Effects of sodium bicarbonate and yeast on nutrient intake, digestibility, and ruminal fermentation of light-weight lambs fed finishing diets. Small Rumin. Res. 67, 149-156.

Khorasani, G.R. & Kennelly, J.J., 2001. Influence of carbohydrate source and buffer on rumen ferementation characteristics, milk yield, and milk composition in late-lactation Holstein cows. J. Dairy Sci. 84, 1707-1716.

Krause, K.M. & Oetzel, G.R., 2006. Understanding and preventing subacute ruminal acidosis in dairy herds: A review. Anim. Feed Sci. Technol. 126, 215-236.

Moseley, G. & Antuna-Manendez, A., 1989. Factors affecting the eating rate of forage feeds. In: Proc. XVI Int. Grassland Congress. Ed. Jarrige, R. Nice (France), 4-11 October 1989. French Grassland Society, pp. 789-790.

Newbold, C.J., Wallace, R.J. & McIntosh, F.M., 1993. The stimulation of rumen bacteria by Saccharomyces cerevisiae is dependent on the respiratory activity of the yeast. J. Anim. Sci. 71 (Suppl.1), 280.

NRC. 2001. Nutrient Requirements of Dairy Cattle. 7º Revised Edition. National Academy Press. Washington D.C., USA.

Owens, F.N., Secrist, D.S., Hill, W.J. & Gill, D.R., 1998. Acidosis in cattle: A review. J. Anim. Sci. 76. 1, 275-286.

Pérez-Ramírez, E., Delagarde, R. & Delaby, L., 2008. Herbage intake and behavioural adaptation of grazing dairy cows by restricting time at pasture under two feeding regimes. Animal 2, 1384-1392.

Thivierge, M.C., Chouinard, P.Y., Lèvesque, J., Girard, V., Seoane, J.R. & Brisson, G.J., 1998. Effects of buffers on milk fatty acids and mammary arteriovenous differences in dairy cows fed Ca salts of fatty acids. J. Dairy Sci. 81, 2001-2010.

Ungar, E.D., 1996. Ingestive behaviour. In: The Ecology and Management of Grazing Systems. Eds Hodgson, J. & Illius, A.W., CAB International. pp. 185-218.

Waldo, D.R., 1986. Effect of forage quality on intake and forage-concentrate interactions. J. Dairy Sci. 69, 617-631.