The sound of chewing

J.R. Galli[1], C.A. Cangiano[2], E.A. Laca[3] and M.W. Demment[3]
[1]Facultad de Ciencias Agrarias, Universidad Nacional de Rosario, C.C. 14. (2123) Zavalla, Santa Fe, Argentina, Email: jgalli@agatha.unr.edu.ar, [2]E.E.A. INTA Balcarce, Departamento de Producción Animal, C.C. 276 (7620) Balcarce, Buenos Aires, Argentina, [3]Department of Plant Sciences, The University of California, Davis, California, USA 95616

Keywords: acoustic analysis, grazing, ingestion, rumination, intake

Introduction Acoustic biotelemetry has been proposed as a way to count ingestive bites and chews of grazing animals. Recent work has indicated the possibility that detailed analysis of 'sounds of chewing' contains information about other characteristics of the ingestive process that can be used to study grazing behaviour of free ranging animals (Laca & Wallis DeVries, 2000), or to monitor stall-fed animals in more detail.

Materials and methods Steers (n=3; 284-316kg) were offered 4 levels (75, 150, 225, and 300 g DM) of 4 forages (fresh lucerne, dry lucerne, dry oats, fresh cocksfoot), at 2 particle lengths, in a factorial design with 32 treatments. They had previous experience with all forages and were offered each treatment once, for enough time to allow them to consume most of the forage. Until the animal chewed and swallowed all food, which took between 100-700s, wireless microphones (Nady 155 VR, Nady Systems, Inc., Oakland, California) transmitted the sounds to the sound track of a VHS video recorder. Rubber foam, placed on the animal's forehead and fastened to a halter, protected the microphones. The recorded sounds were digitised and analysed using Cool Edit Pro (Syntrillium Software 2002). After removing the "silent" intervals between chews, total energy flux density (EFD, pJ/m^2) was determined for the chewing sounds of each session. Average intensity (amplitude or loudness, AI) of chews, EFD/unit time eating, number of chews, and time of chewing were measured also.

Results EFD and AI (Table 1) were good predictors of the dry matter intake measured in each session for all forages (R^2=0.80), grouped in fresh and hay (R^2=0.86), or each type of forage (R^2=0.88). The best regression models combined total EFD and AI. However, treatment did not affect AI, and AI alone was not a good predictor of intake (R^2=0.08). The prediction equations tended to differ between dry and fresh forages. This is consistent with the documented "crunchiness" measured for human foods.

Table 1 Relationship between dry matter intake and chewing sound

Forage type	No. predictors	Coefficients in the model			R^2
		EFD (β_1)	AI (β_2)	β_0	
All	1	103.1	(NA)	48.8	0.59
	2	142.0	-37.4	136.5	0.80
Fresh	2	125.9	-28.2	103.3	0.89
Hay	2	158.1	-42.5	153.3	0.83
Lucerne	2	143.3	-41.9	157.9	0.80
Grass	2	146.6	-34.8	123.7	0.81

N=90

Model: Dry Matter Intake (g DM)=$\beta_0 + \beta_1$ Total EFD+β_2 AI

Conclusions These data and previous work (Laca & Wallis DeVries, 2000), show that the energy of chewing sounds related strongly with the amount of forage ingested. While the sounds of feeding hold considerable potential for more accurate assessments of ingestive behaviours, sound characteristics contain considerable information related to the intake and the nature of the ingested forage. Grazing sounds of free-ranging animals may be monitored telemetrically and recorded automatically to make inferences about intake.

References

Laca, E. A. & M. F. Wallis DeVries (2000). Acoustic measurement of intake and grazing behaviour of cattle. *Grass and Forage Science*, 55:97-104.