Intake Rate Oscillations at the Meal Scale: The Dynamics of Feeding Choices for Coping with Diversity on Rangelands

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Intake rate oscillations at the meal scale : the dynamics of feeding choices for coping with diversity on rangelands

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Introduction On rangelands and natural grasslands , domestic ruminants have to cope with the high diversity of plant species and plant secondary compounds (Provenza and Villalba , 2006) . Foraging responses of ruminants challenged with this chemical and taxonomical diversity have poorly been documented in their dynamic dimension (Gillingham *et al* . 1997 , Agreil *et al* . 2005) . In this study , we aim at modeling the temporal dynamics of foraging during meals , and discuss the results as a contribution to the understanding of ruminants feeding strategies .

Materials and methods Two experiments were conducted in France on sheep (see Agreil *et al* . 2005) . Foraging behavior was recorded by direct and continuous observation of bites (Agreil and Meuret 2004) . Log-transformed intake rate kinetics were analyzed by modeling their variograms (Lajaunie *et al* . 1999) . As experimental variograms were too complex to be fitted by only one basic model of variogram , we used a combination of several basic models . Finally , filter kriging was used for extracting the three components from the observed intake rate kinetics .

Results and Discussion The experimental variograms were satisfactorily modeled by a sum of three basic models : a long-range exponential model , a damped cosine model , and a short-range exponential model . Intake rate time series can thus be interpreted as the sum of three components , respectively structured by :(1) an exponentially decreasing dependence , which can be considered negligible for lags longer than 20 min ;(2) correlation coefficients that are successively positive and negative , generating an oscillating pattern , with pseudo-periods of respectively 19 .6 and 14 .7 min for experiments 1 and 2 ; (3) an exponentially decreasing dependence , considered negligible for lags longer than 2 min . The three components were extracted by filter kriging the observed log-transformed time series of each bout (see an example on Figure 1) . Temporal patterns could be interpreted as the quantitative consequence of the foraging strategies of ruminants faced with diversified vegetation . Oscillations , which are frequent in biological systems , are sustained and not damped in our case . Oscillating patterns of intake (pseudo-period about 20 min) may represent transient aversions to specific plant secondary compounds (PSC) which saturate detoxification and elimination pathways in the animal (Provenza and Villalba , 2006) . Transient reductions in food intake may reflect critical threshold of PSC in blood plasma that initiates an aversion . This would allow for processes of detoxification and elimination to take place . Once concentrations of PSC are below critical thresholds , the animal will resume eating the species associated with the specific PSC (Foley *et al* . 1999) . Some of the species tested in the present study contain alkaloids (*e .g* . *Genista cinerea* , *Genista purgans*) which through the pharmacokinetic processes described may reflect the cyclic patterns .

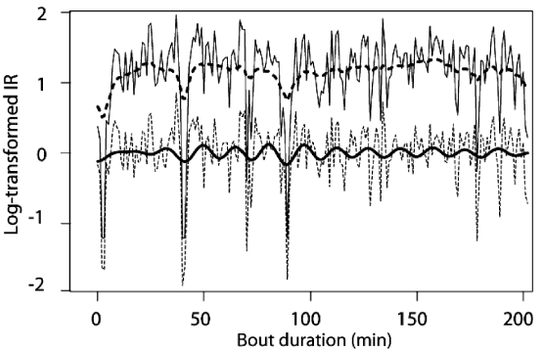

Figure 1 *Filter kriging during one bout , as an example . The log-transformed intake rate time series (thin solid line) is represented with the filtered trend (thick dotted line) , the oscillating component (thick solid line) and the short-range (thin dotted line) .*

Conclusions Our results provide insights on the dynamics of the foraging process , which could help to link short-term feeding choices with their nutritive and toxicological consequences .

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