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How do I cope with that bush? Optimizing less palatable feeds at pasture using the MENU model

M. Meuret

INRA-SAD, Ecodéveloppement, Domaine Saint-Paul, Site Agroparc,
84914 Avignon Cedex 9, France

SUMMARY - To learn how to use rangelands profitably, livestock farmers must have a clear understanding of how they can influence herd behaviour (using external appetite-stimulating factors) to make the animals consume diets consistent with targeted production objectives with minimum external inputs. The feed value of rangelands results to a large extent from the feeding management which can take advantage of the heterogeneity of pastoral areas (MENU model), a factor usually considered as a structural constraint. The overall palatability of each intake component may be considered to result from its *intrinsic palatability* (i.e., mainly related to metabolic regulations linked to the digestion process) and from its *circumstantial palatability* (derived from previous learning by the animals and from the grazing conditions). This leads to characterizing the specific roles assigned to individual paddocks in the daily feeding process and dispensing with the « pastoral potential » concept, of little operational value in our conditions. Taking account of the foraging herd's behavioural responses poses new questions to nutrition scientists about the time dimension involved in the feeding process: the short-term effects of interactions between different feeds, of meal sequences during the day, of feed shifts between the grazing seasons and even the long term effects of behavioural learning.

Key words: Rangeland grazing, modelling, small ruminants.

RESUME - "Que peut-on faire de ces broussailles? Valorisation sur parcours d'aliments de moindre appétibilité en utilisant le modèle MENU". Pour acquérir un savoir-faire dans l'utilisation des terres de parcours, les éleveurs doivent comprendre en quelle mesure ils peuvent influencer sur les comportements de leurs troupeaux (en utilisant des facteurs externes de stimulation de l'appétit) afin que ceux-ci ingèrent des rations qui satisfassent à leurs objectifs de production, tout en ne nécessitant pas un recours systématique à des aliments complémentaires. Or, la valeur alimentaire d'un parcours résulte pour beaucoup des modalités de conduite du troupeau au pâturage et l'organisation de l'alimentation pâturée peut tirer un grand avantage de l'hétérogénéité des parcelles (modèle MENU) en ne considérant plus cette hétérogénéité comme une contrainte, bien au contraire. L'appétibilité globale des aliments pâturés (les plantes ou les organes de plantes) peut être considérée comme la résultante de deux composantes : l'appétibilité intrinsèque (liée principalement aux régulations métaboliques en rapport avec la digestion) et l'appétibilité circonstancielle (liée aux expériences alimentaires antérieures et aux conditions de pâturage pour un troupeau donné). Un éleveur peut organiser le pâturage de son troupeau de façon à augmenter la part d'appétibilité circonstancielle des éléments de la ration d'appétibilité intrinsèque limitante (par exemple : des broussailles envahissantes). Lors d'un circuit de pâturage conçu par un berger où pour la conception d'un grand parc clôturé, il est possible d'identifier des complémentarités dans l'espace pastoral susceptibles de provoquer des stimulations de l'appétit par synergies alimentaires. Cela conduit bien entendu à oublier totalement le concept de « potentialité pastorale » des milieux, qui n'a plus de sens, dès lors que la valorisation du pâturage résulte d'une organisation influant sur le comportement alimentaire. La prise en compte du comportement au pâturage et des façons de l'influencer par le choix d'un mode de conduite pose de nouvelles questions relatives à la dimension temporelle du processus d'alimentation : effets des interactions à très court terme entre prises alimentaires, effets des successions entre repas au sein de la journée, effets des transitions entre régimes selon les saisons de pâturage, effets à très long terme des apprentissages alimentaires.

Mots-clés : Pâturage sur parcours, modélisation, petits ruminants.

Introduction

In southern Europe, scrub encroachment due to the decline of pastoral practices is progressively closing up large tracts of land, making them unfit for uses such as hunting, tourism or gathering of wild resources. To stem this process local communities are taking advantage of European agri-environmental measures and pass contracts with livestock farmers to promote a « pastoral redeployment » based on new management practices (Deverre *et al.*, 1996; Hubert *et al.*, 1996; Léger *et al.*, 1996). Grazing is expected to curb the invasive dynamics of woody plants such as broom, brambles and juniper. These incentives are also expected to progressively change the perception farmers have of the possible uses of their pastoral areas by making them view rangelands as a worthwhile resource. Most livestock farmers feel secure in applying the clear-cut technical guidelines for trough feeding, with the result that indoor feeding of animals has found its way even into the heart of mountain areas. Rangeland grazing, when suggested, is viewed by the farmers as a hazardous venture entailing too many risks for their animal performance objectives. Livestock advisors for their part can offer little help as they lack the means to reliably assess rangeland feed resources. The wide diversity of rangeland resources and the selective eating behaviour of animals makes it near impossible to predict the nature and feed value of what they eat. In addition, precise calculation of the animals' requirements is difficult due to the fact that they move about on the grazingland.

Methods and results

Our work aims to show how a farmer can achieve adequate animal performances from rangeland grazing (for instance: 700 l milk from a goat feeding on rangeland for more than 6 months in the year with no hay supplementation) by managing the feeding of his herd in a way that does not rely on prior knowledge of the nutritive value of intake (based on forage value tables) nor on precise calculation of energy requirements. We used methods inspired from different disciplinary approaches:

(i) Social surveys and on-farm interviews (Kaufmann, 1996) about the production systems and pasturing management practices of a network of farmers applying European agri-environmental measures.

(ii) On-farm surveys (production recording and land mapping) in pasturing situations aimed at controlling shrub encroachment (Hubert, 1994; Girard and Hubert, 1996).

(iii) Direct observation of grazing behaviour using the stratified-bites method adapted to heterogeneous pastures (Meuret, 1989; Dumont *et al.*, 1995).

We show first that ingestibility of rangeland diets (in *Quercus ilex* and *Q. pubescens* coppices and *Genista* heathland) in small ruminants used to feeding in this type of environment is not constricted by the *a priori* limiting value of feeds (80 to 120 g DM/kgLW^{0.75}/day) obtained from a mix of plants with organic matter digestibility values between 45 and 65%. By analysing meal kinetics, we are then able to demonstrate that what predominantly motivates intake is the possibility of diversifying the diet during a meal (Meuret and Bruchou, 1994) and from one meal to the next along the day (Meuret, 1993). High fiber feeds having low palatability when offered alone serve as fiber roughage when mixed with other grazed feeds, which considerably improves their ingestibility. As a result of this observation we dropped the traditional diet calculation method based on additive models of feed values and considered the feed value of the whole diet, including effects linked to animal intake behaviour.

We developed a model called MENU based on an analysis of the shepherding practices of herders experienced in stimulating their animals' appetite on heterogeneous rangelands (Meuret *et al.*, 1994; Meuret, 1996). The grazing circuit devised by a shepherd may be viewed as an ordered sequence of offered feeds, the objective being to constantly revive the animals' interest through successive feeding phases having synergic effects on their appetite (Fig. 1 top left). When intake must be stimulated in a particular site with rough and less palatable resources (for instance a patch to be cleared of scrub), this model enables the farmer or his herder to detect and mobilize complementary, contiguous zones in the grazing area. These can play six distinct roles (or phases) in

a meal, and their use value is assessed individually according to two simple criteria: the relative abundance and the relative palatability of the resources.

The Menu

Synergic feeding sequence that increases dietary motivation

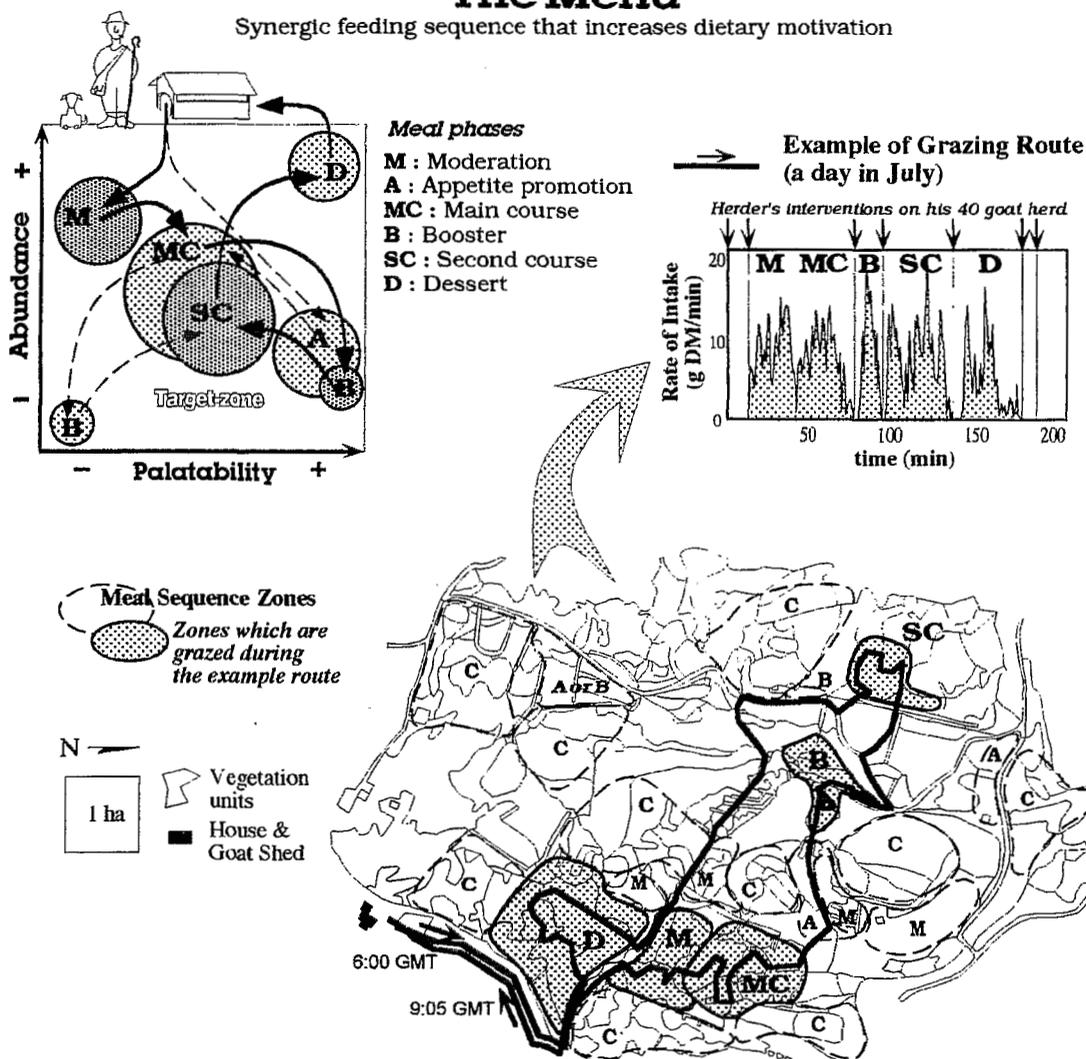


Fig. 1. The MENU model (top left of figure) consists of a sequence of synergic phases within a meal, corresponding to distinct areas the herder plans to use when organizing the herd's daily grazing route in order to stimulate intake of the coarsest resources (« Target Zone »). The « useful diversity » of the territory results from the division of the land into units that are potentially complementary in a planned sequence of meals (i.e., within a goat farm territory of 40 ha, bottom right of figure).

The MENU model provides the farmer with a total picture of his territory. Planning for synergic phases in the meals may be a good way to consider how the territory is to be structured over several years (Fig. 1 bottom right). By observing the responses of his herd to the different resource types, the farmer will learn to identify the nature and location of areas that are limiting and decide, if necessary, to create new areas (by plowing up the land for crops, mechanical scrub clearing or clearing of undergrowth vegetation) that will be assigned specific roles in the course of the grazing day. An example are small sainfoin plots (*Onobrychis sativa*): by being strategically sited along the grazing circuits, they may increase the area exploited by 50% as a result of their synergic effect which improves the ingestibility of rough resources by more than 20% (Meuret *et al.*, 1995).

Herders are, however, becoming a rare breed in Europe and as a result livestock systems increasingly resort to using fixed fences, chiefly to economize on labour. We therefore went on to explore whether, and how the MENU model could be used to design a large paddock (approximately 10 ha) so as to draw maximum advantage from spatial heterogeneity in order to secure a sequential use of synergic zones and a targeted diet along the herd's spontaneous route. We show that daily intake profiles may be achieved in this way, comparable to those obtained under the guidance of a herder, i.e., highly dynamic and consisting mainly of meals lasting more than 60 minutes (Meuret *et al.*, 1995).

Discussion

To learn how to use their rangelands, the livestock farmers must have a clear understanding of how they can influence herd behaviour to make the animals consume diets that meet their targeted production objectives with minimal external inputs. In other words, which external appetite-stimulating factors can the farmer manoeuvre? We show that the feed value of a rangeland results largely from a feeding management that takes advantage of the heterogeneity of pastoral areas, a factor usually considered as a structural constraint. The overall palatability of each intake component may be considered to result from its *intrinsic palatability* (i.e., mainly related to metabolic regulations linked to the digestion process) and from its *circumstantial palatability*. The latter is derived from previous learning by the animals and from the grazing conditions. Now, it is clearly possible to modulate animal dietary habits, develop the relation between the herder and herd and organize the daily feeding patterns so as to increase the overall palatability of resources having low intrinsic palatability by boosting their circumstantial palatability.

Some grazing management models are now starting to take into account livestock management practices which can influence animal feeding behaviour, in order to overcome supposed constraints due to the forage value of some paddocks. This leads to characterizing the spectrum of use values of a grazed paddock assigned one or several specific roles in the daily feeding process. The concepts of « pastoral potential » and « carrying capacity » are dispensed with since they have little operational value in our conditions. Taking account of herd behavioural responses on rangeland areas poses new questions to nutrition scientists regarding the time dimensions involved in the feeding process (Provenza, 1995; Provenza, 1996; Sauvant, 1996): the effects of short term interactions between different feeds, of meal sequences along the day, of feed shifts between the grazing seasons, and even the long term effects of behavioural learning.

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