Forage quality prediction model as a function of grazing height

Ana Luiza Silva Carvalho[1], Otávio Goulart de Almeida[1], Ana Paula Combraia Vital[1], Janaina Azevedo Martuscello[2], Daniel de Noronha Figueiredo Vieira da Cunha[2], Liana Jank[3],

KEYWORDS: Crudeprotein, FDN,intermittent stocking, Panicummaximum

INTRODUCTION:The use of grazing systems in intermittent stocking has increased in properties intended for milk production, aiming, in general, to improve the quality of avalilableforage, increasing stocking rate and reducing production costs. Pasture management directly affects forage quality and consequently animal production. Pedreira&Mattos (1982) found that variations in monthly rates of biomass accumulation may result in qualitative changes during the year or even during the season of the year, even when the grass is used with equal intervals between grazings, as is the case of rotational stocking systems used traditionally.

Mombaçagrass has been used in rotational systems with new management recommendations aimed at a pre-grazing height of 90 cm, since this correlates with 95% light interception (Carnevalli et al., 2006). Some studies have been conducted to establish the ideal post-gazing height for mombaçagrass, indicating the height between 30 and 50 cm to present better results in relation tocanopy structure (Cunha et al, 2010).

Regardless of the post-grazing height it is important to note that in rotational systems, as pasture is consumed, forage quality tends to decrease and consequently production, thus mathematical models that explain these variations need to be selected. Thus, the aim with this work was to select mathematical models that best predict quality as a function of grazing height.

MATERIAL AND METHODS: The experiment was conducted at the Federal University of São João del Rei, on an established mombaçagrasspasture (Panicum max*imum* Jacq.), managed under intermittent stocking with

[1] Undergraduate in Animal Science – Federal University of São João del-Rei/MG – Brazil. ana_silvacarvalho@hotmail.com

[2] Professor of theDepartament of Animal Science–Federal Universidadeof São João del-Rei/MG – Brazil. janaina@ufsj.edu.br

[3] Researcher at Embrapa Beef Cattle – Campo Grande/MS – liana.jank@embrapa.br

pre-grazing height of 90 cm and post-grazing of 30 cm. The total area was 4.5 ha, subdivided into 18 paddocks with 0.25 ha each. Grazing intervals corresponded to the time necessary for mombaçagrassto reach 90 cm height.Rest and occupation periods were determined according to the number of days that the animals remained in the paddocks and the number of days required for the height of 90 cm to bereached after the removal of the animals. After the removal of the animals the paddocks were fertilized with 75 kg of NPK 20-0-20 formula. For the maintenance of the post-grazing residues lactating F1 cows (Holstein x Zebu) were used, adopting an average stocking rate of 7.4 AU/ha ± 1.6.To evaluate forage quality, everyday during all grazing cycles (six cycles with an average duration of five days), five samples per paddock were taken from 0.5 m^2 squares for composition of one composite sample which was subsampled and separated into leaf, stem and dead matter. The morphological components were weighed and dried in an air-forced drier, ground and analyzed using the near infra--red spectroscopy (NIRS), from Embrapa Beef Cattle, estimating the values of crude protein (CP), neutral detergent fiber (NDF),*in vitro*dry matter digestibility (IVDMD) and lignin in acid detergent for leaves, stem, and total forage.

To perform the analysis, linear, potential, logarithmic, quadratic and powerfunctions were compared. Function parameters were fit and values were calculated for the following set of evaluators: Mean Square Error (MSE), mean square of the prediction errors (MSPE), coefficient of determination (R^2) and fitbaesian information criterion (CBI). For every forage quality variable the function that produced the best fit was selected,according to the criteria used. The SAS procedure MODEL was used.

RESULTS AND DISCUSSION:

In Table 1, it may be observed that the logarithmic model was the one that showed the best fit to forage crude protein (FCP) and stem NDF (SNDF). The quadratic model was the one that fit best the characteristics forage (FLC) and leaf (LLC)lignin concentrations, stem (SP) and leaf (LP) percentages and the stem (SOMD) and total forage (FOMD)in vitro organic matter digestibilities. For leaf crude protein (LCP) and leaf NDF content (LNDF) the model that best fit was the potential. For FCP and LP, decreasing levels were observed as pasture height decreased, in other words, as grazing pressure increased. Forage quality decreased. In fact, in the early days of the grazing cycle there is more supply of leaf lamina and consequently higher levels of protein in the animal diet.As the pasture is consumed, NDF and lignin levels increase as may be seen in Table 1. In the first days of grazing, the canopy structure consists of large amount of leaf, which will be consumed as the grazing cycle advances, thus changing the pasture structure. Thus, in the botanical composition, the stem structure prevails over the leaves, consequentlyreducing the forage quality. Thus, as the grazing cycleadvances, there is resistance of the animals to forage consumption, which may be explained by the higher percentage of stem as the pasture is lowered. In fact, Carvalho et al. (2014) in a study of mombaçagrass managed at 30 cm height,discussedthe difficulty in maintaining the residue. The authors also elucidate the higher milk production in pastures managed at 50 cm post-grazing height when compared to those managed at 30 cm. This can be explained by the canopy structure in larger grazing intensities. The models evaluated in this study corroborate with these information, since they clearly show a decrease in protein and digestibility of the forage and increase in the levels of NDF and lignin as thepasture is consumed.

Table 1. Forage prediction model which best fits each characteristic

Charac-teristic	Modela-dopted	Values of the param-eters of the model			Values of the decision criteria			
		a	*b*	*C*	**MSE**	**MSPE**	**R²**	**CBI**
FCP	Logarithmic	-2,7473	3,0252	-	0,5979	0,5672	0,6691	97,945
LCP	Power	6,3773	0,1494	-	0,5787	0,5490	0,4091	96,6724
FLC	Quadratic	8,1877	0,1323	0,0008	0,1242	0,1146	0,7433	40,3199
LLC	Quadratic	7,7529	0,1224	0,0009	0,0949	0,0876	0,7751	29,8219
SP	Quadratic	86,3720	1,7725	0,0113	44,5070	41,0834	0,6144	269,6981
LP	Quadratic	13,0452	1,4394	-0,0081	32,8057	30,2822	0,7325	257,8014
SNDF	Logarithmic	87,4906	2,1151	-	1,0039	0,9524	0,3706	118,1557
LNDF	Power	93,5803	0,0526	-	3,0818	2,9237	0,4045	161,8988
SOMD	Quadratic	42,3358	0,2323	0,0031	15,0889	13,9282	0,4765	227,5124
FOMD	Quadratic	43,2905	0,0928	0,0020	6,6754	6,1619	0,6519	195,7064

FCP:Forage crude protein, LCP: Leaf crude protein, FLC: Forage lignin concentration, LLC: Leaf lignin concentration, SP: Stem percentage, LP: Leaf percentage, SNDF: Content of stem NDF, LNDF: Content of leaf NDF, SOMD: Stem*In vitro* organic matter digestibility, FOMD: Forage*in vitro*organic matter digestibility

CONCLUSIONS: Quality ofmombaçagrasspastures decreases as grazing pressure increases.

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