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MANAGEMENT OF PASTURE BASED ON DMpd. REVIEW

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ABSTRACT

The aim of this study is to discuss the management of pasture based on potentially digestible dry matter (DMpd). Tropical forage species are used in the extensive system as the main source of roughage for cattle. Tropical forages have nutritional deficiencies, mainly in the dry season, due to the low rainfall and climatic adversities, and it is interesting to use alternatives to supply this deficit or management that help in production of good quality roughage. Research shows it is necessary to conceptualize and quantify the potentially digestible dry matter (DMpd), since the availability of total dry matter (TDM) does not qualitatively characterize pastures, but higher potentially digestible dry matter content guarantee better animal performance. There is a correlation between the quality of forage, DMpd and indigestible neutral detergent fiber, which should be evaluated in each forage species to assist the management of pastures in relation to total forage masses, green forage masses, green leaf blades, dead forage and stem dead.

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INTRODUCTION

The extensive breeding system is the most adopted in Brazil, the pastures when well managed, are the lowest cost food for cattle production, a variable that has the greatest economic impact on production systems, since diet and food management are the most onerous factors in this activity (01). According to Santos *et al*. (2017), tropical forages provide low-cost energy substrates, mainly fibrous carbohydrates. However, climatic in clemencies and seasonality limit the cattle production system into pasture, especially during the dry season of the year. During this period, low rates of animal production are observed, due to the low availability of pasture accompanied by poor quality of the forage material, since at this period occurred changes in the composition of the pasture, such as an increase in stem size, a greater lignification of the cell walls, reduction of leaf: stem ratio, elevation of dead matter, among others, able to decrease the digestibility of the forage consumed by the animals. Detmann *et al*. (2014) showed the importance of ensuring the availability of forage mass during the dry period of the year, since it is considered a latent energy bank. In this way, researchers use techniques to improve forage utilization, one of them being the correct management of pastures, as well as the use of protein supplements in the dry season to provide nitrogenous compounds for the growth of ruminal microorganisms, and to favor the use of the dry matter that is potentially digestible, but which will only be used if the ruminal microorganisms are able to degrade it. Potentially digestible dry matter is related to the supply of potentially digestible forage, which involves pasture structure (forage mass, pasture height, leaf: stem ratio) and pasture quality, as well as NDFI levels. Therefore, it is necessary to adopt management principles for quantity and also management for tropical pasture quality, since the supply of forage based on potentially digestible dry matter may raise the level of animal response, especially in the dry season year. Potentially digestible dry matter is a new study tool that assists in the management of pasture and animal nutrition, and for its adoption it is necessary to know the values of indigestible neutral detergent fiber, which variable has been evaluated only in research present (Paulino *et al*., 2008b). The objective of the literature review was to discuss pasture management based on DMpd. To achieve this objective, a careful bibliographical review was conducted to obtain the data and subsidies necessary to discuss the proposed theme.

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MATERIALS AND METHODS

A careful research was carried out in journals indexed in Capes Periodicals, with *qualis* in the area of Animal Science from May 21 to July 17, 2018, being used as reference articles, dissertations and theses on the subject of the study. For the search were used the following keywords and terms: Potentially digestible dry matter, indigestible neutral detergent fiber, neutral detergent fiber corrected for ash and protein, dry matter availability, forage quality.

Forage management and production based on DMpd

Information about feed used in ruminant nutrition, as well as diet adequacy, are essential for estimating animal performance more accurately. In this way, it is possible to add value to the activity through precision farming, in which productive responses must be predicted for as accurately as possible (Detmann *et al*., 2005a). The quantity and quality of grazing are important factors that influence the productivity of grazing cattle, but this breeding system can present adversities during the dry season of the year if there is not adequate planning (Casagrande, 2010). The requirements of grazing animals are not supplied throughout the year due to the seasonality and effect of this on forage productivity, therefore the nutritional adjustment between the forage supply curve, nutrients available and the grazing cattle demand is a necessary to reach greater efficiency of production systems. The adjustment assists in the food management, since it can cover the eventual deficits that occur by several factors, associating the management principles for quantity and management for quality of the tropical pastures by means of the potentially digestible dry matter thus raising the level of response animal at these times. Thus, pasture management is primarily aimed at the production of fodder with high levels of potentially digestible fiber. Reis *et al*. (2012) observed plant and animal responses as a function of pasture height management, which allowed the control of the forage mass and the stocking rate, which favored the simultaneous determination of pasture quality and quantity. It was also possible to observe that low digestion tissues have a negative correlation with crude protein (CP) and in vitro dry matter digestibility (IVDMD), and a positively correlation with fiber and lignin contents. The deferred pastureadopted by several producers predisposes pasture camp, especially those whose stems are thin and flexible, such as those of the Brachiaria genus, which results in an inadequate structure for consumption (Santos *et al*., 2009). The pasture falling index correlates positively with the masses of total forage, dead forage and dead stems, whereas, negatively with the masses of green forage and green leaf blade mass, in this way the DMpd of deferred pastures will be smaller when compared to well managed pastures with entry and exit of the animals in the right period, that is, the management actions that result in deferred pasture with more advanced maturity stage, with a higher occurrence of reproductive tillers and dead, to the detriment of vegetative tillers, contribute to increase pasture falling index and to reduce grazing efficiency (Santos *et al*., 2010b). Thus, Paulino *et al*. (2008b), with an innovative objective, demonstrated a new way to evaluate the quality of the forage that is the potentially digestible dry matter, an integrative measure of the quantitative and qualitative aspects of the pasture, that allows greater precision of the real capacity of support and performance of the area used, the equation being described as follows:

$$DMpd = [0,98*(100 - NDF) + (NDF - NDFi)]$$

DMpd = Potentially digestible dry matter.
NDF = Neutral detergent fiber (%DM).
NDFi = Indigestible neutral detergent fiber (% DM).
0,98 = True digestibility coefficient for non-NDF components.

Santos *et al*. (2004) recommend averages of 4.0 to 5.0 kg of DMpd / 100 kg of body weight per day, necessary to promote support to precision livestock farming that aims to exploit the genetical enhancement limits of the animals. However, there are still few studies in the literature that analyzed the forage NDFi contents, making it impossible to perform a comparative analysis of DMpd on the performance of cattle. According to Paulino*et al*. (2008b) the need to conceptualize and quantify DMpd arose because the availability of total dry matter does not qualitatively characterize pastures, thus Detmann *et al*. (2010) argue that the higher the content of potentially digestible dry matter, the better the animal performance is likely to be, which makes it possible to increase the use of available basal resources, reducing the use of supplementation and probably raising financial gain. Research evaluating correlations between number of tillers, falling index, mass of morphological components and forage nutritive value in deferred pastures of *Brachiaria decumbens* observed a positive correlation between the morphological component, green leaf blade mass with percentage of CP, neutral detergent fiber potentially digestible (NDFpd), and DMpd and negative correlation with NDF and NDFi. In this way, the mass of dead stems was negatively correlated with the levels of CP, NDFpd and DMpd and positively with the contents of NDF and NDFi (Santos *et al*., 2010b). Some authors and producers admit the use of supplementation for animals to cover the quantitative deficiencies of DMpd which occurs most often in the dry season, as well as correcting the nutrient imbalances presented by the basic forage resource that affects tropical forages (Paulino*et al*., 2008b), the supplementation delineated under these principles has a positive effect on the production when the amount of DMpd of pasture offered is low and its effect is due to the decrease in the consumption of forage DMpd promoted by the supply of supplementation, allowing the mass of pre-grazing forage to be used by a larger number of animals, that is, the grazing stocking rate can be increased by supplementation.

Management for quantity and quality

In most cases, it is at the beginning of the rainy season that the best opportunity to gain live weight is offered (Figueiredo, 2005), but during the grazing season, with the accumulation of residual dry matter there is an increase in the structural fraction and reduction of the general quality of the available material. This is because the management based on the maintenance of the apical meristem (management for quantity) allows the forage plant to regrow vigorous and fast, once it is processed from the remaining leaf area beyond the production and expansion of new leaves originating from the apical meristem. Tropical forage plants lose their nutritional value as maturity progresses, due to the high growth rate, and considering the preference of the cattle for tender regrowths, control of the vegetative stage of the forage at the time of harvest by the animal, regardless of the species, is the parameter that most affects diet quality (Figueiredo, 2005). The ideal characteristics of the pasture to increase the dry matter consumption by the animal are determined when elimination

of the apical meristem of the primary tiller in strategic grazing (management for quality) ocurred. After the elimination, the plant maintains the apical meristem low, shows regrowth through gemasbasilares, maintaining a high percentage of leaves and new tillers, placing at the disposition of the animal material rich in new leaves and stems in quantity and density that contribute to increase the consumption. Leaf life varies according to the cultivar / species and the type of growth, being greater during regrowth. We must use the phenotypic plasticity of the forage grass in order to adapt it to grazing. The use of intense grazing, with a less requirement and selective animal category, is aimed at removing the residual grazing material, at least three times during the year: end of the dry season (immediately before beginning of regrowth), mid rainy season (interspersed with grazing cycles aiming maximum production of dry matter) and the end of the rainy season (immediately before the beginning of pasture deferring for the dry season) (Paulino *et al*., 2008b).

Table 1 shows the compilation of several studies evaluating crossbred animals in *Brachiaria brizantha* and *Brachiaria decumbens* pastures in the different seasons of the year, in order to show the values of potentially digestible dry matter. The availability of potentially digestible dry matter (DMpd) found in the several compiled works for the *Brachiaria brizantha* forage presented an average of 69.11% or 3,656.38 (Kg / ha) and total dry matter availability (DMt) of 5,442.20 Kg / ha, values higher than those found for *Brachiaria decumbens*, with averages of 66.34% or 3.152 (kg / ha) DMpd and 4,704.15 (kg / ha) of DMt. Research have shown that there is a negative correlation of DMpd with the amount of indigestible neutral detergent fiber (NDFi), as it increases the NDFi content in forage species, reducing the proportion of DMpd in grasses. Considering the importance of the use of tropical forage species and their participation in Brazilian livestock breeding, studies have shown the relevance of a correct management in order to obtain not only quantity but also quality, since these aspects influence animal productivity. Structural parameters such as height, leaf / stem ratio, amount of green and senescente material are indications for a correct management in the pastures. In this way, it observes that the better and more efficient the management, the higher the levels of DMpd available in the plant, as a consequence will be offered roughage of better quality to the animals, providing efficiency in the performance, precocity of the system, reduction in the expenses with supplementation, with pasture recovery and economic viability to property.

The highest values of DMpd were found by Dias *et al*. (2015), Nascimento *et al*. (2009), Nascimento *et al*. (2010), Pesqueira-Silva *et al*. (2015), Schio*et al*. (2011) e Souza (2015), probably these results may be related to the period in which the experiments were carried out (water period and dry transition / water) showing the influence of good climatic conditions such as precipitation of rain and temperature under quality of tropical forage species. These data show the potential use of these grasses in animal feed without the need for supplementation, thus reducing feed costs during this period of the year, emphasizing the importance of pasture fertilization. Baroni*et al*. (2010), Carvalho *et al*. (2009), De Paula *et al*. (2010) e Silva-Marques *et al*. (2015) found averages of 64.40; 64.70; 67, 18 and 66.87% of DMpd respectively, high percentages even in dry period, when compared to other works. These values are probably related to the climate of the Mato Grosso region which is tropical hot with an average annual precipitation of 1,480 mm. Lins (2015) working with animals under intermitente grazing of *Brachiaria brizantha* cv. Marandú in the southwestern region of Bahia in the dry period of the year found an average of 72.87% of DMpd, a high value when compared to the other works carried out in the water period, probably this result is related to nitrogen fertilization of pasture maintenance that occurred in the of the rainy season and that possibly provided productive response of the grasses. Benatti *et al*. (2012), Mateus *et al*. (2011) e Porto *et al*. (2011) found the lowest percentages of MSpd, probably because they worked in dry periods without precipitation, without pasture fertilization and with low temperatures ranging from 15 to 20º in the region of Viçosa and inclement weather the southwest of Bahia, respectively. Santos *et al*. (2010) correlated morphological components with nutritive value of deferred grazing of *Brachiaria grass* according to Table 2. The results indicate that the green leaf and the dead stem are the main determinants of pasture quality, since they presented significant and opposite correlations with all nutritional value characteristics, mainly DMpd (Table 2). Although there may be variations in the nutritional value of each morphological component of the pasture (Santos *et al*., 2002), these variations are of smaller magnitude when compared to the difference of nutritive value between these components. This is because each plant's morphological component consists of specific tissues (Paciullo *et al*., 2002), organized with cells and chemical substances that guarantee the proper functioning of the organ in the plant.

The Table 3 shows the compilation of several studies evaluating crossbred animals in pastures of *Brachiaria brizantha* and *Brachiaria decumbens* in different seasons, in order to show the values of productive performance as a function of the potentially digestible dry matter. The availability of potentially digestible dry matter found in the different compiled works for the *Brachiaria brizantha* and *Brachiaria decumbens* forages presented a mean of 73.12%, 0.813 (kg / day) of average daily gain, 1.87 (UA / ha) and 59.13% of digestibility, values obtained in the various seasons of the year and in several regions. It was expected that the higher ADG were found by those authors who observed higher pdDM levels in the pasture, but the results showed that not always those animals that were under grazing with grass with a higher percentage of pdDM had higher mean daily gains, probably these implications may are related to several factors when it comes to animal management, such as supplementation, age and race. Dias *et al*. (2015), Macedo (2014), Nascimento *et al.*(2009), Porto *et al*. (2008) e Souza (2015) showed higher ADG averages when compared to the other studies, 0.835; 0.627; 0.734; 1.022.25 and 0.611kg / day. Probably the results are related to the period of evaluation that concentrated in the waters and water / dry transition, with the digestibility of the diet and supplementation with higher levels of protein varying from 30% for some of these authors. Minor ADG values were found for Baroni*et al*. (2010), Lins (2015), Nascimento *et al*. (2010), Pereira (2015) e Silva-Marques *et al*. (2015), but these results show a satisfactory average daily gain, since these experiments were conducted in the dry period of the year. Possibly the results are related to the quality of forages that reduces in this period of low precipitation, data observed through the low digestibility of the diet. Most of these studies worked with animal supplementation, a fact that favored ADG and did not promote a reduction in productive performance, since supplements supplied nutrient deficiencies of tropical forages.

Table 1. Season of year, potentially digestible dry matter, neutral detergent fiber, indigestible neutral detergent fiber and total dry matter availability of *B. decumbens* and *B. brizantha* pastures according to several authors

		Brachiariabrizantha				
Authors	**Season**	**DMpd(%)**	**DMpd(kg/ha)**	**NDF (%)**	**NDFi(%)**	**DMt (Kg/ha)**
Carvalho*et al*., 2009	Dry	64.70	3692	72.72	-	5718
Baroni*et al*., 2010	Dry	64.40	4755	73.89	35.12	7385
De Paula *et al*., 2010	Dry	67.18	3817	69.84	23.44	5682
Mateus*et al*., 2011	Dry	60.70	4083	83.03	38.56	6727.6
Schio*et al*., 2011	Transition	68.95	4454	78.10	24.75	8406.4
Benatti*et al*., 2012	Dry	53.39	1308	75.24	40.5	2465.0
Silva Marques *et al*., 2015	Dry	66.87	2525	69.90	22.2	3775.8
Pesqueira Silva *et al*., 2015	Transition	70.98	2880.3	68.26	20.21	4057.8
Dias *et al*., 2015	Rainy	84.86	5191.8	69.69	13.94	6118.0
Souza, 2015	Transition	85.37	3894.1	61.92	-	4560.9
Lins, 2015	Dry	72.87	3620	80.49	26.51	4968
Average	-	69.11	3656.4	73.00	27.24	5442.20
	Brachiariadecumbens					
Porto *et al*., 2008	Rainy	65.82	3140	65.63	17.66	4770
Nascimento *at al*., 2009	Transition	70.19	3026	63.79	17.04	4311
Nascimento *et al*., 2010	Rainy	72.13	4222	72.67	20.64	5853
Porto *et al*., 2011	Dry	57.22	2220	66.22	29.40	3883
Average	-	66.34	3152	67.07	21.18	4704.3

DMpd = potentially digestible dry matter, NDF = neutral detergent fiber; FDNi = indigestible neutral detergent fiber; DMt = total dry matter availability Adapted from: Baroni *et al*., 2010; Benatti *et al*., 2012; Carvalho *et al*., 2009; De Paula *et al*., 2010; Dias *et al*., 2015; Lins, 2015; Mateus *et al*., 2011; Nascimento *et al*., 2009; Nascimento *et al*., 2010; Pesqueira *et al*., 2015; Porto *et al*., 2008; Porto *et al*., 2011; Schio*et al*., 2011; Silva Marques *et al*., 2015; Souza, 2015.

Table 2.Linear correlations between masses of morphological compounds and nutritive value of forage in Brachiaria deferred pastures

	Morphological component of forage			
Variable	**Green leafblade**	**Green Stem**	**Deadleafblade**	**DeadStem**
CP	0.73	0.15	-0.54	-0.45
NDF	-0.63	0.57	0.28	0.73
DMpd	0.71	0.62	-0.56	-0.74

Adapted from Santos *et al*., 2010.

Table 3. Season of year, average daily gain, stocking rate, potentially digestibility dry matter and digestibility of *B. decumbens* and *B. brizantha* pastures according to several authors

Authors	**Season**	**ADG (g day-1)**	**RS (UA ha-1)**	**DMpd(%)**	**Digestibility (%)**	**Specie**
Porto *et al*., 2008	Rainy	1022.25	2.53	65.82	65.59	*Brachiariadecumbens*
Carvalho *et al*., 2009	Dry	751	1.22	64.70	-	*Brachiariabrizantha*
Nascimento *et al*., 2009	Transition	734	1.67	70.19	58.64	*Brachiariadecumbens*
Nascimento *et al*., 2010	Rainy	573	2.14	72.13	56.22	*Brachiariadecumbens*
Baroni*et al*., 2010	Dry	302	0.81	64.40	-	*Brachiariabrizantha*
Macedo, 2014	Dry	627	2.12	77.02	56.16	*Brachiariadecumbens*
Silva Marques *et al*., 2015	Dry	557	1.42	66.87	-	*Brachiariabrizantha*
Dias *et al*., 2015	Rainy	835	1.50	84.86	57.96	*Brachiariabrizantha*
Souza, 2015	Transition	611	2.30	85.37	57.43	*Brachiariabrizantha*
Pereira, 2015	Dry	477	2.80	80.15	71.27	*Brachiariabrizantha*
Lins, 2015	Dry	586	2.15	72.87	49.84	*Brachiariabrizantha*
Average		813	1.87	7312	59.13	-

ADG= average daily gain, RS= stocking rate, DMpd = potentially digestibility dry matter, Adapted from Baroni *et al*., 2010; Carvalho *et al*., 2009; Dias *et al*., 2015; Lins, 2015; Macedo, 2014; Nascimento *et al*., 2009; Nascimento *et al*., 2010; Pereira, 2015; Porto *et al*., 2008; Silva Marques *et al*., 2015; Souza, 2015.

Final considerations

Only the availability data of total dry matter has not been satisfactory to estimate the performance and support capacity of a certain area. It is necessary to characterize the forages qualitatively, so the DMpd evaluation assures that the higher the content of potentially digestible dry matter, probably will result in better animal performance, allowing to increase the use of the basal resources available in the plant and reduce the use of supplementation. However, the impediment of these evaluations are the few works in the literature that analyzed the forage NDFi contents.

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