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Nutritive Value of Selected Naturally Growing Dry Season Pastures in Flood Plains of Kafue River in Southern Zambia

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ABSTRACT

Wetlands are an important source of pastures for livestock forage in the dry season in arid and semi-arid regions. In this study, forage samples were collected during the dry season (September to November) to evaluate the nutritive value for the potential to supply livestock requirements during the dry season under the transhumance system of livestock production in the Kafue Flood Plains in Mazabuka District of Southern Province. The frequency, height and cover of the grass species in upper and lower parts of the grazing area were measured. Proximate components, fibre fractions and *in-vitro* dry matter digestibility were determined using standard laboratory procedures. The grass species found in the upper land were *Acroceras macrum,* and *Vetiveria nigritana* at the frequency of 60 and 56%, respectively. *Panicum repens, Polygonum spp* and *Cyperus papyrus* are the grass species that were found in the lower area at a frequency of 44, 52 and 80%. Ground cover was 69 and 100% for upper and lower area, respectively. The crude protein was significantly different among the species *Vetiveria nigritana* (7.90%) and *Polygonum salicifolium* (8.46 %), *Cyperus papyrus* (6.12%) and were also higher than for *Panicum repens* (3.37%) and *Acroceras macrum* (3.32%) ($p < 0.05$). Crude fiber ranged from 12.8% (*Polygonum salicifolium*) to 34.6% (*Vetiveria nigritana*). *Polygonum salicifolium* had higher *in-vitro* dry matter digestibility (INVDMD) (50.8%) followed by *Vetiveria nigritana* (46.4%), *Cyperus papyrus* (44.5%), *Panicum repens* (39.9%) and *Acroceras macrum* (39.7%) at ($p < 0.05$). These results clearly show that the some of the grass species of the Kafue flat have good nutrition content and, therefore, are a good source of nutrition for ruminants in the dry season.

Keywords: *Digestibility, Forage, Livestock, Wetland, Kafue Flats, Zambia*

INTRODUCTION

In Zambia, as in various parts of the tropics most pastoralists rely on grasses as a major feed source for grazing animals. However, forage quality declines during the dry season. Dry season feed resources are the major factor affecting

long-term livestock numbers in the semi-arid region (Chibinga *et al.,* 2016). Dry season available feedstuffs have low concentration of digestible nutrients including energy, proteins, vitamins and minerals and as such, animals grazing natural pastures and crop residues perform poorly as manifested through reduced body weight gains and milk production levels (Simbaya *et al.,* 2020). The poor performance of animals is due to the nutritional imbalance in the feed (Chibinga *et al.,* 2012). To mitigate this problem of low-quality pastures when forage on the surrounding uplands is becoming scarce during the dry season, pastoralists take their animals to flood plains or wetlands when the waters recede. These wetlands cover 30% of agricultural land in Southern Zambia (Kulich and Kaluba 1984).

In Zambia, a wetland in southern Zambia, the Kafue Flats contribute significantly not only to fisheries but also wildlife and livestock grazing (Chabwela *et al.,* 2018). The region is home to the highest concentration of cattle in the country, with an estimated 20% of the national herd (290,000 cattle) grazing on the flats in the dry season (Shanungu *et al.,* 2017). With the limited and low-quality pasture and water in the highlands, especially in the dry season (April to November), cattle are moved to the plains (transhumant herds). Mumba *et al.,* (2005) stated that some of the larger herds, which cannot find sufficient grazing land around the village, are kept permanently on the plains (flood-plain grazing) and these animals compete for grazing pasture and water with the wildlife. Chabwela (2018) and Blaser 2013 reported that this area is characterised by grass species of *Acroceras macrum Vetiveria nigritana, Panicum repens Polygonum species* and the *Cyperus papyrus.* It is therefore, important to evaluate the nutritional quantitative value of the grasses that are utilised as grazing pastures for the livestock. This is due to the fact that the nutritional value of the pasture is neither well known nor documented, despite having an increasing number of animals to be sustained in the area. Chibinga *et al.,* 2010, indicated that it is important to identify the indigenous forage species, which are used more than before and promote their utilisation to ensure sustainability of livelihoods of the pastoralists. However, despite knowing this species found in Kafue plains, there is no information on the nutritive values of these pasture species. For most of the forage species identified in dry tropical Africa, knowledge of local production and that of chemical composition is still insufficient. Overcoming this constraint would ensure maximisation of the use of this fodder by livestock. It is, therefore, important to measure the chemical composition of the pasture species and to carry out in-vitro digestibility studies in order to determine the level of usefulness and effectiveness of the selected species as feed for animals.

This study was conducted to determine the nutritive value of selected pasture species in order to ascertain the usefulness as feed to ruminants in the dry season.

MATERIALS AND METHODS

Study Area

The study was conducted in the flood plains of the Kafue Flats in Chief Mwanachingwala's area in Mazabuka. The Kafue wetland covers between

4400 and 6500 km^2 (Dudley, 1979; Scott 2003; Mumba and Thompson, 2005), lies between latitudes 15 º 30' and 16º 0' south and longitudes 26º 05' and 26º 10' east with a distance of 380 Km between Itezhi-tezhi and Kafue town. According to Scott Wilson, (2003); Mumba and Thompson, (2005), this area or flats floodplain extends 40-56 km at its widest point. The area flooded varies seasonally as well as inter-annually depending on the amount of precipitation received per rain season. The traditional economic activities of this area include transhumance cattle husbandry where cattle herders live in the flood plain for at least six months in the dry season, and during the wet season, cattle are moved to their upland permanent homes on the flood plain periphery/plateau where they are grazed. This is because the flats are inundated annually due to their having low gradient with poorly drained soils.

Vegetative Sampling

Vegetative field sampling of the pastures was done in the lower region (within 50 meters from the river) and in the upper region (within 50 to 150 meters from the river). Sampling was done at plot levels. 1 meter x 1 meter fifty (50) plots were systematically sampled at random on the landscape in order to quantify species frequency, height, and ground cover. Species in both the upper and lower landscapes. Frequency was measured as applied by Abercombie *et al.,* (1980) based on the percentage of occurrence of individual plant species in relation to the total number of observation points. Accordingly, the abundance status of each plant genera or family was categorised as dominant (frequency of occurrence of ≥15%), common (frequency of occurrence of 6-14%), less common (frequency of occurrence of 4-5%) and uncommon or scarce (frequency of occurrence of <4%).

Species ground cover was estimated by eye or visual assessment, and then the estimate was recorded as percentage of the total area of a 1 x 1m square quadrant. The average height of each grass species was measured using a measuring tape and recorded.

Nutritional Analysis

The chemical composition of the grass samples collected was determined by the use of proximate analysis were the following parameters were analysed: Dry Matter (DM %) using Official Methods of Analysis, AOAC (1990); crude protein (CP %) using the Kjeldahl method; Ether Extract (EE %) using AOAC official methods 920.39; Crude fibre (CF %) using AOAC official methods 962.09; Neutral Detergent fibre (NDF %), Acid detergent fibre (ADF %), Lignin (%), Cellulose (%), Hemicellulose (%), total tannins, Ash (%) and key minerals such as Calcium (Ca %) using permanganate method; and Phosphorus (P%) using Vanodo-molybdate method. In-vitro dry matter digestibility (IVDMD) of the leaves was determined following the methods of Tilley and Terry (1963), by incubating in a thermostatically controlled water circulating bath. The data were subjected to the Analysis of Variance (ANOVA) using the General Linear Model (GLM) of Minitab Reference Manual Release 16 (Minitab, 2012).

RESULTS AND DISCUSSION

The frequency of the grass species in the grazing area was found to be highest in *Acroseras macrum* (60%) in the upper region and *Panicum repens* (80%) in the lower region, Table 1. All the grass species had a frequency higher than 50% except *Polygonum species*. The ground cover was better in the lower region (100%) compared to the upper region (69%). *Cyperus papyrus was the* tallest (310 cm) *and Acroceras macrum* was the shortest (7cm). The high dominance of A*croseras macrum* in the upper region and *Panicum repens* in the lower region of the grazing area could be due to ecological preference. These grass species are usually dominant in very wet areas of wetlands where there is less competition with other grass species, which are not suitable to wet areas. Rojas-Sandoval (2023) indicated that *Panicum repens* occurs in both aquatic and terrestrial plant communities and is common along edges of rivers irrigation channels, lakes, wetlands at elevation of up to 2000 meters. Usandizaga *et al.,* (2014) reported that *Acroseras macrum* grows in humid areas and Hyde *et al.,* (2023) also indicated that *Acroseras macrum* is common on-stream sides, pond margins and swampy places. The implication of this is that these pasture species will continue to be an important source for grazing animals during the dry season.

Nutritive value of pasture species in the Kafue flats are presented in Table 2. Results showed that Dry Matter (DM) content of all grasses ranged from 71.0% *(Acroceras macrum) to* 94.1% *(Polygonum salicifolium)*. Crude Protein (CP) ranged between 3.32% (*Acroceras macrum*) to 8.46% (*Polygonum salicifolium*). The average CP of 5% in pastures is just enough to meet the minimum nutrient requirements for grazing animals (Leng, 1990) and from the results only two pasture species (*Acroceras macrum* and *Panicum repens*) have CP lower than 5%, which means that the other three pastures have enough CP requirements for grazing animals. However, Van Soest (1994), recommended that the minimum CP requirement level for ruminants is (70-80g/kg $^{-}$DM) below which intake and rumen microbial activity would be affected. To improve performance, animals consuming forages with less than 7% crude protein (CP) will require the supplementation to achieve maximum production (Ondiek *et al.,* 2000). These pastures also have higher crude protein than hay which is normally less than 5%. Kearl (1982) indicated a range of 11-13% CP to be adequate for maintenance and growth requirements of goats and sheep. The results obtained show that the protein levels are inadequate to meet the requirements for sheep and goats. These pastures would, therefore, require supplementation with legume pastures.

The concentration of Calcium (Ca) among the pasture species ranged from 0.37%-0.95%. The highest value was noted in *Polygonum salicifolium* (0.95%) and the lowest in *Cyperus papyrus* (0.37%). The concentration of Phosphorus (P) among the pasture species ranged from 0.20-0.26% with the mean value of 0.23%. The highest value was noted in *Cyperus papyrus* (0.24%) and the lowest in *Acroceras macrum* (0.20%) and *Vetiveria nigritana* (0.20%). According to National Research Council (1984) cited by Abdullah *et al.,* (2013), the recommended range, on mineral nutrients for all classes of ruminants are 0.19-0.82% Ca and

0.12-0.48% P. The Ca recorded in all the forage species is within the recommended range, while the amount of P was also within the recommended range. The results on P levels contrast with Inam-ur-Rahim (1999), Akhtar *et al.,* (2007) and Sultan *et al.,* (2009) who has observed P deficiency in various forages. In-vitro dry matter digestibility was found to be highest in *Polygonum salicifolium* (50.8%) and lowest in *Acroceras macrum* (39.7%). This range is in agreement with Njau *et al.,* (2013) who found a range of 35.7% to 56.6% in pastures in the communal grazing land of semi-arid central Tanzania. The higher the digestibility the better, the nutrition level of feedstuff. Crude protein was positively correlated with IVDMD (R =0.94) (Figure 1). This is simaliar to what Giridhar *et al.,* (2018), also observed. A positive correlation between IVDMD and CP indicate that as the crude protein increase, there was an improvement in IVDMD.

Generally, as the crude protein level increases, so does the digestibility of the leaves. Higher levels of CP result in increased ruminal ammonia N concentration, which in turn, enhances microbial activity and growth resulting in greater DM digestibility (Griswold *et al.,* 2003).

CONCLUSION

Results from this study clearly showed that Kafue wetlands land has some pasture species of good nutritive value for optimal animal production. Improved and adaptable pasture species should be introduced in this communal grazing area for the improvement of the grazing area. It is also recommended for the farmers to find the way of conserving these natural grasses to ensure sustainable production of livestock in the area.

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Table 1 Frequency, Average Height and Cover of the Grass Species

Region	Grass Species	Frequency (%)	Average Height (cm)	Ground Cover (%)
Upper Region	*Acroceras macrum*	60	7	69
	Vetiveria nigritana	56	125	
Lower Region	*Polygonum spp*	44	140	100
	Cyperus papyrus	52	310	
	Panicum repens	80	183	

Table 2: Nutritive Value of the Pastures in Kafue Flats

Parameter	Grass Species			
	Acroceras macrum	*Vetiveria nigritana*	*Panicum repens*	*Polygonum salicifolium*
	Cyperus papyrus			
DM (%)	71.0±0.26^{d}	88.9±0.08^{b}	76.0±0.14^{c}	94.1±1.13^{a}
	75.3±0.55^{c}			
CP (%)	3.32±0.10^{d}	7.90±0.07^{b}	3.37±0.82^{d}	8.46±0.10^{a}
	6.12±0.01^{c}			
EE (%)	3.07±0.03^{b}	2.89±0.02^{c}	2.15±0.02^{e}	2.48±0.03^{d}
	3.50±0.03^{a}			
CF (%)	26.0±0.07^{c}	34.6±0.13^{a}	28.3±0.38^{b}	12.8±1.46^{d}
	34.3±0.00^{a}			
ASH (%)	13.8±0.30^{a}	11.7±0.72^{a}	9.89±3.16^{a}	9.09±4.36^{a}
	9.10±4.38^{a}			
Ca (%)	0.55±0.02^{b}	0.51±0.03^{b}	0.51±0.10^{b}	0.95±0.01^{a}
	0.37±0.01^{c}			
P (%)	0.20±0.00^{e}	0.20±0.00^{d}	0.25±0.00^{b}	0.24±0.00^{c}
	0.26±0.00^{a}			
NFE (%)	22.5±0.58^{c}	33.6±0.68^{b}	27.8±2.73^{bc}	66.4±6.89^{a}
	19.9±5.05^{c}			
IVDMD(%)	39.7±0.45^{c}	46.4±1.83^{b}	39.9±0.43^{c}	50.8±1.75^{a}
	44.5±0.59^{b}			

Note. Values with different superscript within rows are significantly different ($P < 0.05$).

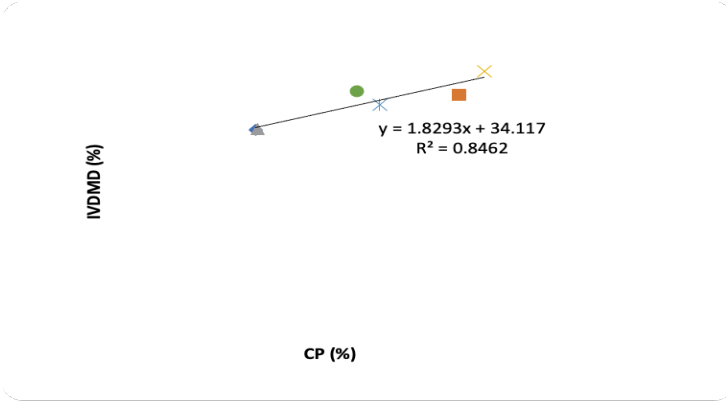

Figure 1. Relationship between IVDMD and CP Content of the Grass Species