Partial nutritional evaluation of some browser plant species utilized by communal livestock in the Eastern Cape Province, South Africa

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Abstract

The aim of the study was to establish the nutritional value of different browse species utilized by communal livestock farmers, in various local municipalities of Amathole and O.R. Tambo districts of the Eastern Cape, South Africa. Leaves from twelve different browse species i.e. *Vachellia karroo, Prunus persica, Ziziphus mucronata, Diospyros dichrophylla, Vepris lanceolata, Haemanthus coccineus, Grewia occidentalis, Schotia latifolia, Calpurnia aurea, Olea europaea* subsp. *africana, Cordia rudis and Mimusops obovata,* were identified and collected during the dry season (June). The chemical composition of these samples was determined using standard laboratory analytical techniques. Nutritional elements of importance analyzed included: Ash, Ca (Calcium), Mg (Magnesium), K (Potassium), Na (Sodium), P (Phosphorous), Zn (Zinc), Cu (Copper), CP (Crude Protein), CF (Crude Fiber), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF). It was found that, CP, CF and Ash content of the leaves ranged from 1.9-18.5%, 1.7-47.6% and 6.0-20.5% respectively. The NDF and ADF ranged from 17.6-37.26% and 17.6-69.54% respectively. Minerals such as Ca, Mg, K, Na and P ranged from 1.2-9.71%; 0.0-1.436%; 0.0-2.08%; 0.0-0.072% respectively, whilst Zn, Cu, Fe and Mn values were 0.7-23.6 ppm, 6-1 ppm, 3.0-566.9 ppm and 4-662 ppm respectively. In the light of the present data, it can be concluded that certain browse species are within normal range in nutritionally important elements. However, in some plants, imbalances do occur and additional supplementary feeding should be considered.

Keywords: nutritional value, browsers, communal livestock, communal sector
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Introduction

Despite the high number of livestock under communal rangelands in South Africa, overall productivity is quite low compared to the commercial sector. Among other factors, nutrition is a major constraint, limiting livestock performance (Kiff *et al*, 1999). Livestock on communal grazing areas depend on low quality roughages during dry winter months for their nutrient requirements (Becholie *et al*., 2005). Communal livestock is characterized by a high level of mortality, low reproductive rate, low weaning percentage (Bembridge, 1989; Devendra, 1990) and severe weight loss especially during the dry season from May to August. However, it has been found that browse trees maintain relatively higher nutritive value than grass from pasture during the dry season. Therefore, improvement in livestock productivity under low pasture quality conditions can be enhanced by the addition of small amounts of supplements in the form of browse plants that can provide some of the required nutrients.

In many parts of the world, browse species play an important role in livestock feeding (Arzani *et al*., 2006; Azim *et al*., 2011, Fayemi *et al*., 2011). Apart from feeding, browse species have multiple roles in farming systems including use as fire wood as well as in ethno-veterinary medicines (Luseba & Van der Merwe, 2006). Browse species contain appreciable amounts of nutrients that are deficient in other feed resources such as grasses during the dry season. According to Teferi *et al*. (2008), most browse species have deep root systems enabling the extraction of water and nutrients deep in the soil profile and thus increase crude protein of the foliage. Information on the nutritive value of plants used as fodder species during the dry season is limited in the Eastern Cape Province of South Africa. Hence, the present study was conducted with the objective of evaluating the nutritive value of browse species as potential supplementary livestock fodder.

Materials and Methods

The study was conducted during June 2013 in three municipalities of the Eastern Cape Province of South Africa, namely Keiskammahoek, Willowvale and Lusikisiki. These local municipalities fall within the Amathole and OR Tambo districts of the Eastern Cape Province.

Leaves from 12 browse species, *Vachellia karroo, Prunus persica, Ziziphus mucronata, Diospyros dichrophylla, Vepris lanceolata, Haemanthus coccineus, Grewia occidentalis, Schotia latifolia, Calpurnia aurea, Olea europaea* subsp. *africana, Cordia rudis and Mimusops obovata* were collected during the dry season (June) at three different local municipalities. Not all species were present and utilized at all three sites. Samples were pooled in cases where some of the plant species occurred in more than one location. The species samples were collected based on the information (part of plant used and where can you find the species in the area/forest) obtained from local communal farmers. Samples were collected by hand picking and portions thereof, pressed, dried according to standard botanical practices and mounted on herbarium sheets for later identification using Flora of South Africa as illustrated in the published book "Trees of South Africa".

Another portion of the collected samples was oven dried at 40^0C for 48 hours. Dried samples were ground in a Willey mill to pass through a 1mm sieve. Grounded samples were labeled and kept in paper bags until chemical analysis was performed.

Nutrient composition of leaves was determined according to methods of the AOAC (2002). Neutral and acid detergent fiber were analyzed according to Van Soet *et al.* (1991). The mineral composition was determined on ash using an atomic absorption spectrophotometer. A flame photometer was used for potassium and sodium analysis.

A basic statistical application was used for all statistical analysis (Statistica 12, 2013). This was done as samples were pooled and no between plant species and site comparison could be performed for the different variables.

Results and Discussion

The chemical composition of different browse species showed wide variation. The crude protein (CP), crude fibre (CF), ash and fibre fractions (Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF)) are depicted in table 1.

Table 1 Crude protein, crude fibre, ash and fibre fractions of browse plant species during the dry season

Genus/species	Common Name	Xhosa Name	Chemical composition & fibre fraction (%)				
			CP	CF	Ash	NDF	ADF
Vachellia karroo	Sweet thorn	Umnga	6.50	29.50	20.50	21.82	23.27
Prunus persica	Peach	Umpesika	18.50	11.30	7.40	32.37	61.12
Ziziphus mucronata	Buffalo thorn	Umphafa	12.31	11.00	*	25.76	66.02
Diospyros dichrophylla	Poison star-apple	Umbhongisa	10.50	1.68	8.90	24.74	35.94
Vepris lanceolata	White ironwood	Umzane	16.94	15.70	10.80	26.75	69.54
Haemanthus coccineus	Paintbrush Lily	Intlolokotshane	7.25	12.60	8.80	26.13	65.62
Grewia occidentalis	Cross-berry	Umnqabaza	6.00	14.40	12.70	32.83	26.99
Schotia latifolia	Forest boer-bean	Umngxam	9.38	20.20	6.00	37.26	38.74
Calpurnia aurea	Wild laburnum	Umbethe	8.50	47.60	13.60	17.64	17.61
Olea europaea subsp. *africana*	Wild olive	Umnquma	8.25	18.90	7.10	36.84	36.28
Cordia rudis	Small bone-apple	Intsinde	13.69	17.80	*	30.91	54.77
Mimusops obovata	Red milkwood	Umntunzi	1.94	14.90	15.30	29.33	36.61
Mean			**9.98**	**17.97**	**11.11**	**28.53**	**44.38**

(*) - sample not analyzed due to small sample volume

The Crude Protein (CP) content of the browse species varied between 1.94-18.5% and the mean was 9.98. It is considered that plants with a CP level below 7% are deficient and may not maintain body weight in an animal (Gidado *et al.*, 2013). In a study conducted by Dambe *et al* (2015) on the nutritive value of some browse species in the semi-arid mixed Mopane bushveld of Botswana it was reported that older leaves

had lower crude protein content (6.09%). Van Soet (1992) indicated that crude protein content of browse species should be higher than the minimum level of 7-8% of DM for optimum rumen function and feed intake in ruminants. The mean crude fibre (CF) content analysis showed that crude fibre (CF) content of various browse plants used for feeding livestock in the study areas varied from 1.68-47.6 %. *Prunus persica* recorded the highest value and the lowest being *Mimusops obovata.* The ash content recorded in the current study was found to be within the range (6-20.5%) of what has been previously reported (Abdullah *et al*., 2014). *Vachellia karroo* had the highest ash content and the lowest being *Schotia latifolia* with a mean value of 11.11. Contrary to the findings of this study, where the ash content ranges between 6-20.5%, Topps (1993) reported that the ash content of forages and feeds range between 8-10%. The mean Neutral Detergent Fibre (NDF) values for the browse species analyzed were 28.53 with a range of 17.64-37.26%. The NDF was highest in *Schotia latifolia* (37.26%) and the lowest in *Calpurnia aurea* (17.64%). NDF values were lower than those reported by Gidado *et al* (2013). Oni *et al* (2008) reported that browse species which have a NDF content above 50% also contain high proportions of soluble carbohydrates which are beneficial for proper rumen function. The ADF analysis indicates a mean of 44.38 with a range of 17.61-69.54%. The low to moderate fibre content of the plant species analyzed, indicate their desirable nutritive value since fibre plays a significant role in voluntary intake and digestibility.

The macro-mineral content for Calcium (Ca), Magnesium (Mg), Potassium (K), Sodium (Na) and Phosphorous (P) and micro-minerals content of Iron (Fe), Copper (Cu), Zinc (Zn) and Manganese (Mn) is depicted in table 2.

Table 2 Mineral composition of browse plants during the dry-season

Genus/specie	**Macro-minerals (%)**					**Micro-minerals (%)**			
	Ca	**Mg**	**K**	**Na**	**P**	**Fe**	**Cu**	**Zn**	**Mn**
Vachellia karroo	3.873	0.389	1.486	0.072	0.105	151.10	12.00	5.60	9.00
Prunus persica	1.417	0.061	1.227	*	0.169	566.90	13.00	15.90	9.00
Ziziphus mucronata	2.732	0.007	1.429	*	0.065	135.40	8.00	8.20	662.00
Diospyros dichrophylla	1.161	*	0.862	0.002	0.072	3.04	10.00	1.90	248.00
Vepris lanceolata	3.589	0.102	1.022	0.002	0.070	216.60	11.00	11.50	220.00
Haemanthus coccineus	2.016	0.126	0.925	0.002	0.041	267.20	6.00	9.20	143.00
Grewia occidentalis	9.152	0.551	2.080	0.045	0.052	187.50	10.00	8.70	96.00
Schotia latifolia	2.302	0.390	1.784	0.024	0.116	87.60	9.00	0.70	4.00
Calpurnia aurea	9.710	1.436	1.680	0.012	0.352	137.10	10.00	23.60	120.00
Olea europaea subsp. *africana*	5.817	0.380	1.606	0.015	0.111	116.70	10.00	3.40	64.00
Cordia rudis	1.224	0.013	1.716	0.002	0.196	242.50	11.00	8.20	40.00
Mimusops obovata	1.283	*	0.029	*	*	201.80	10.00	1.30	242.20
Mean	**3.69**	**0.35**	**1.32**	**0.02**	**0.12**	**192.79**	**10.00**	**8.18**	**154.77**

(*) - sample not analyzed due to small sample volume

The concentration of Ca varied from 1.161-9.71% with a mean of 3.69. The highest value of Ca was recorded in *Calpurnia aurea* (9.7%) and the lowest in *Mimusops obovata* (1.161%). The National Research Council (NRC)(1984), recommended that 0.19 to 0.82% is suitable for all classes of ruminants. In the present study, the concentration of Ca was higher than recommended levels. According to NRC (2001), a Ca content above 1% can result in a decrease in DM intake and upset the absorption of trace minerals especially Zinc (Zn).

The highest concentration of Mg was recorded in *Calpurnia aurea* (1.436%) and the lowest on *Ziziphus micronata* (0.007%), with a mean of 0.35. The recommended Mg requirements for animals range 0.12-020% in the feed of ruminants (NRC, 1985). The maximum value based on our findings was within the minimum requirements for lambs (0.8-1.5%), lactating sheep and goats (0.9-1.8%) and lactating cows (1.2-2.1%). The minimum value of 0.007 shows a deficiency of magnesium in *Ziziphus micronata*, which might be caused by the type of soil in which the plants were growing. Sultan *et al* (2009) reported that sandy and acid soils are deficient with Mg.

The mean concentration of K was 1.32 and it ranged from 0.029 to 2.08%. It was the highest in *Grewia occidentalis* and the lowest in *Mimusops obovata*. Results showed that concentration of K in browse species based on critical values was outside the recommended range of 0.60% - 0.80% recommended by the NRC (1996) and McDowell *et al* (1984).

Sodium (Na) content varied considerably between browse species from 0.002 to 0.072% and the mean value was 0.02. A maximum Na content was observed in *Vachellia karroo* and the lowest in *Diospyros Dichrophylla, Vepris lanceolata, Haemanthus coccineus*.and *Cordia rudis*. Browse species with a lower than recommended Na level might results in weight and appetite loss, decreased growth and a reduction in milk production (McDowell & Valle, 2000). The recommended range of Na for all classes of ruminants is 0.06 to 0.18% (NRC, 1984).

The mean concentration of phosphorous was 0.12 with the highest in *Calpurnia aurea* (0.35%) and the lowest in *Haemanthus coccineus* (0.041%). According to National Research Council (1994) the recommended levels of P for all classes of ruminants range between 0.12 to 0.48%. In the current study the P concentration for *Haemanthus coccineus* was lower than the minimum requirements for ruminants, whereas the maximum values fell within the recommended standards. Minson (1990a) reported that forages from savanna have been described as deficient in P due to low concentration of P in soil. The Ca:P ratio of 1:0.03 obtained generally for the browse plants in this study is below the optimum level of between 1:1 and 4:1 required for the effective utilization of these minerals in forages. Ahamefule *et al.* (2006) reported a similar trend in some plants browsed by cattle in Umudike, South-eastern Nigeria. The phosphorus concentrations in all the browse plants in this study were substantially lower than calcium. This observation is in agreement with the findings of Ibeawuchi *et al.* (2002) who reported that calcium content of browse plants to be higher than that of phosphorus.

The Fe content analysis showed that *Prunus persica* had the highest value (566.9 ppm) and *Diospyros dichrophylla* had the lowest value of *(*3.04 ppm). The Fe levels in all species except *Diospyros dichrophylla* were above the critical level recommended by NRC (1996) for beef cattle and sheep.

The Cu content showed that *Prunus persica* had the highest value (13 ppm) and *Haemanthus coccineus* had the lowest value (6 ppm). Copper is vital for bone formation and acts as a key component of several enzymes in plants. The Cu values correspond with the findings of Minson (1990b), who reported that the Cu may vary from 2.50-13.90 ppm.

The Zn contents were highest in *Calpurnia aurea* (23.6 ppm) and the lowest in *Schotia latifolia* (0.7 pm). Severe deficiency of Zn in certain browse species has been reported by Sher *et al* (2011) which can cause absence of sexual maturation and dwarfism in animals.

The recommended range for Mn is 20 to 50 ppm, as reported by Ensminger & Olantine (1987). The Mn analysis showed that *Ziziphus mucronata* had the highest value (662 ppm) and *Schotia latifolia* had the lowest value (4 ppm). The results from this study supported the findings of Minson (1990b) who has reported that the contents on Mn in pastures can range from 1 to 2670 ppm.

Conclusion

The results show that most selected browse species are rich in crude protein and some macro and micro-minerals concentrations are well within the recommended ranges. These results justify the choice of farmers to actually use these plant species, as most of them can in one way or another be used for supplementary feeding during feed deficient periods of the year. It is important to note that some of these plants are deficient in macro- and micro minerals and imbalances in the ratio between certain key minerals do occur. Additional supplementation should be considered in these cases. Further research is needed to investigate the nutrient and mineral content differences between the same plant species in different locations as well as seasonal differences.

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