Landscape and seasonal effects on crude protein, fibre and *in vitro* fermentation characteristics of common grass species in semi-arid communal grazing lands of South Africa

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51st GSSA Annual Congress, The Wilderness Hotel, 07 July 2016

BACKGROUND

- Communal rangelands sustain a large proportion of the livestock of South Africa
- Grasses make up the largest proportion of the native pastures, and therefore contribute the bulk of livestock forage nutrients
- Native pastures have been reported to have lower CP and higher fibre content that negatively affects intake and digestibility
- Marginal deficiencies of protein and energy in native pastures result in low livestock performance and productivity

PROBLEM STATEMENT

- One of the biggest challenges in communally based livestock production system in South Africa is the fluctuation in quality of available forages

- There is inadequate information with respect to changes in protein, fibre and *in vitro* fermentation characteristics of grasses as influenced by season and landscape position

JUSTIFICATION

- Unravelling nutrient quality trends of rangeland forages over landscapes & seasons will assist in predicting spatial & temporal variations in livestock nutritional status and,

- allow for the timely implementation of corrective measures of grazing management & nutrient supplementation

OBJECTIVES

- The objective of this study was to investigate the effect of season (autumn, summer, spring and winter), and landscape gradients (upland, sloping and bottomland) on CP, Fibre and *In vitro* ruminal fermentation.

MATERIALS AND METHODS

Hala (Highveld)

- 32^0 38’ S and 26^0 35’ E, alt. 985m
- Av. rainfall is 800 mm p.a
- The mean temp. in summer is 20^0C and in winter is 8^0C
- Livestock types: Cattle,
  - Sheep,
  - Goats &
  - Donkeys

Gqumashe (Lowveld)

- 32^0 46’ S and 26^0 51’ E, alt. 574 m
- Av. rainfall is 480 mm p.a
- max and min temp. 26 - 41^0C in summer and 5 - 11^0C in winter
- Livestock types: Cattle,
  - Sheep,
  - Goats &
  - Donkeys

Transect establishment and sample collection

- Three long transects that extended from the uplands to the bottom lands were established.
- Along each transect, sites representing the landscape positions were marked making a total of three sites per landscape unit.
- Samples for each species were harvested to a stubble height of 5 - 6 cm from six 0.25 m^2 quadrants per plot, between (2012/13).

Chemical analysis

Grass samples were analyzed for:

- Crude protein (CP),
- Neutral detergent fibre (aNDFom),
- Acid detergent fibre (ADFom), and
- *In vitro* ruminal gas production and degradability

Statistical analyses

- General linear models (GLM) procedure of SAS (2001),

- to test differences between grass species, seasons and landscape gradients.

- Data analysis was done separately for the two study areas.

Table 1. Mean CP, aNDFom and ADFom contents (gkg^{-1} DM) of bulk forage at different landscape positions in the Highland.

Landscape gradient	*CP*	*aNDFom*	*ADFom*
Bottomland	51.6[a]	689.4[a]	376.2[b]
Sloping	44.6[b]	691.5[a]	390.7[a]
Uplands	50.7[a]	678.1[a]	375.6[b]

- [ab] In a column, means with different superscripts differ ($p \leq 0.05$).

Table 2. Mean *in vitro* cumulative gas production (24, 36, and 48 h post-incubation, ml g^{-1} DM), 48h *in vitro* ruminal degradability (48h DMD, g kg^{-1}) and partition factor (PF, mg DMD/ml gas produced) of selected grass species at different seasons in the Highland

Parameter	*Season*	*C. dactylon*	*E. chloromelas*	*E. plana*	*S. africanus*	*T. triandra*
24h	Autumn	611.3[a]	594.0[a]	603.4[a]	596.3[a]	564.5[a]
	Winter	558.7[b]	521.0[b]	521.5[b]	510.3[b]	529.2[a]
36h	Autumn	760.8[a]	749.9[a]	757.4[a]	754.3[a]	685.5[a]
	Winter	668.9[b]	624.7[b]	640.2[b]	632.0[b]	640.3[a]
48h	Autumn	848.4[a]	848.8[a]	864.1[a]	863.3[a]	765.0[a]
	Winter	740.8[b]	693.1[b]	721.7[b]	716.8[b]	719.1[a]
48h DMD	Autumn	457.7[a]	460.7[a]	458.5[a]	467.5[a]	443.7 [a]
	Winter	372.4[b]	285.2[b]	306.4[b]	335.5[b]	355.3 [b]
PF	Autumn	0.54[a]	0.54[a]	0.53[a]	0.55[a]	0.58[a]
	Winter	0.51[a]	0.42[b]	0.43[b]	0.47[b]	0.49[b]

[ab] For each species, within incubation time, means with different superscripts differ ($p \leq 0.05$).

Table 3. Mean (CP), (aNDFom) and (ADFom) contents (gkg^{-1} DM) of bulk forages at different landscape positions in the Lowland communal areas.

Landscape gradient	*CP*	*aNDFom*	*ADFom*
Bottomland	54.8[a]	684.0[a]	373.2[a]
Sloping	56.6[a]	682.4[a]	370.5[a]
Uplands	49.8[b]	678.1[a]	379.6[a]

[ab] In a column, means with different superscripts differ ($p \leq 0.05$).

Table 4. Mean crude protein (gkg^{-1} DM) content of the interaction of season and selected grass species in the Lowland.

	Season			
Grass species	***Autumn***	***Spring***	***Summer***	***Winter***
C. dactylon	76.0^{Cc}	61.9^{Bbc}	61.7^{Bb}	47.8^{Ac}
E. chloromelas	85.4^{Cc}	78.0^{Bc}	64.5^{BCc}	43.9^{Abc}
E. plana	44.3^{ABa}	55.7^{Bab}	48.8^{Bb}	35.5^{Aabc}
S. africanus	51.3^{Cab}	37.5^{ABa}	46.1^{Ba}	27.4^{Aa}
T. triandra	60.8^{Bb}	61.3^{Babc}	51.9^{Bb}	34.6^{Aab}

^{A,B,C} In a row, means with the same uppercase superscripts do not differ ($p > 0.05$)
^{a,b,c} In a column, means with the same lowercase superscripts do not differ ($p > 0.05$)

Table 5. Mean *in vitro* cumulative gas production (24, 36, and 48 h post-incubation, ml g^{-1} DM), 48h *in vitro* ruminal degradability (48h DMD, g kg^{-1}) and partition factor (PF, mg DMD/ml gas produced) of selected grass species at different seasons in the Lowland.

Parameter	Season	*C. dactylon*	*E. chloromelas*	*E. plana*	*S. africanus*	*T. triandra*
24h	Autumn	628.6[a]	587.4[a]	616.7[a]	590.9[a]	598.4[a]
	Winter	532.8[b]	505.5[b]	584.4[a]	515.8[b]	517.4[b]
36h	Autumn	751.2[a]	706.6[a]	759.7[a]	708.0[a]	704.0[a]
	Winter	642.8[b]	618.3[b]	699.6[a]	625.3[b]	626.2[b]
48h	Autumn	826.4[a]	785.4[a]	851.8[a]	795.6[a]	784.9[a]
	Winter	714.2[b]	700.1[b]	793.7[a]	704.6[b]	706.7[b]
48h DMD	Autumn	429.4[a]	397.9[a]	384.4[a]	369.6[a]	450.1[a]
	Winter	324.1[b]	313.2[b]	354.6[a]	286.4[b]	332.4[b]
PF	Autumn	0.52[a]	0.51[a]	0.45[a]	0.46[a]	0.57[a]
	Winter	0.46[b]	0.45[b]	0.45[a]	0.41[a]	0.46[b]

[ab] For each species, within incubation time, means with different superscripts differ ($p \leq 0.05$).

Conclusion

- Generally seasonal variation imposed greater influence on nutritive value of grass herbage than spatial variation.
- In both sites, *T triandra* emerged as the grass with the highest potential as ruminant feed.
- Crude protein content of grass herbage in both communal grazing areas was likely to be inadequate for maintenance of ruminant animals, but the severity depends mainly on season.
- This urges the need for protein supplementation in order to improve animal productivity.

ACKNOWLEDGMENTS

Many thanks go to:

✓ Govan Mbeki Research and Development Centre of the University of Fort Hare for funding this project.

✓ Residents of Hala and Gqumashe communal areas for their active participation.