EFFECT OF MATURITY ON NUTRITIVE VALUE OF NATURAL PASTURE IN BUTANA, EASTERN SUDAN

A.G. Mahala*, A.M.A. FadelElseed and L. Abdalla

University of Khartoum, Faculty of Animal Production
Dept. of Animal Nutrition – Shambat 13314 – Sudan

المستخلص

تم جمع سبعة عشر من نباتات المرعي في بداية (يوليو ٢٠٠٧) ونهاية (سبتمبر ٢٠٠٧) موسم الأمطار وتقيمها من ناحية المحتوى الكيميائي ،محتوي العناصر المعدنية وانتاج الغاز .

محتوي المادة الجافة والالياف الخام ازداد من تقدم موسم المطار ، وفي المقابل انخفض محتوي نباتات المراعي من البروتين الخام في محتوي البروتين الخام وضعت ذوات الاوراق العريضة في مستوي أعلي مقارنة مع الاعشاب ، مع حدوث العكس بالنسبه لمحتواها مع الالياف الخام .

تبعا لمحتويات نباتات المراعي من البروتين الخام يمكن ترتيبها تنازليا كالاتي:-

I.oblogfolia>C.olitorus>I.kordofana>R.patulla>A.viridis>P.bicolyata>B.erecta>T.terrestris>S.acromelaena>C.biflorus=C.rotundus>T.portulacastrum>D.muricata>D.annulatum> C.kotschyi> R.exltat> E.colonum.

Key Words: Grasses, Forbs, Maturity Stage, Chemical Composition, Mineral Elements

قيم البروتين الخام تتراوح ما بين ٨.٧٧% الي ٢٣.٢٥% في بداية موسم الامطار ، هذه القيم تتراوح من جيدا جدا الي حسنا بالنسبة لتغذية الحيوان حيث لاتحتاج الي بروتين اضافي وفي نهاية موسم الامطار تتراوح ما بين حسنه الي فقيره وتحتاج الي بروتين اضافي في حالة التغذية عليها .
النباتات ذوات الأوراق العريضه راكمت عناصر معدنية أكثر وخاصه الكالسيوم والنحاس مقارنة مع الأعشاب ، كل العناصر المعدنية المقيّمه هي كافية للاحتياجات الحيوانية في البداية او نهاية موسم الامطار عدا النحاس . في معظم نباتات المراعي المجموعه انخفض انتاج الغاز المعملي مع تقدم النباتات في العمر نتيجه لزيادة مكونات جدار الخلية وخاصة الالياف غير الذائبة في المنظفات الحمضية ، تبعا لذلك يمكن تقييم نباتات المراعي في البطانة علي انها جيده في محتوياتها من البروتين الخام والعناصر المعدنية ،مع الاحتياج الي بروتين أضافي في حالة التغذية علي الاعشاب في نهاية موسم الامطار ..

Abstract

Seventeen pasture grasses and forbs from Butana (eastern Sudan) during early (July 2007), and late (September 2007) season of rainfall, were evaluated in terms of chemical composition, mineral contents and *in vitro* gas production parameters. DM and CF contents were increased with maturity in both lower and upper limits of the range for the pasture grasses and forbs. In contrast, CP contents for both grasses and forbs species decreased with maturity. Forbs were ranked higher compared to grasses in respect of CP contents, while the opposite was occurred in terms of CF contents. According to CP contents at early stage the pasture, forbs and grasses species were ranked as follow: *I.oblogfolia>C.olitorus>I.kordofana>R.patulla>A.viridis>P.bicolyata>B .erecta>T.terrestris>S.acromelaena>C.biflorus=C.rotundus> T.portulacastrum> D.muricata> D.annulatum> C.kotschyi> R.exltat> E.colonum*.

CP values were ranged from 8.77% to 23.15% at early stage, these values were ranged from very good to fair enough for animal feeding which may not need supplements, and from 4.94% to 20.28% at late stage from fair to poor which may need a protein supplement. Forbs accumulate more elements particularly Ca and Cu than grasses. All estimated elements are sufficient for animal requirement either in late or through out the season except Cu element. In most of pasture species the potential gas production decreased with maturity due to increase in structural carbohydrate particularly ADF. Accordingly, Butana pasture could be classified as good in term of CP content and elements (macro and micro) while it may need CP supplements at late season especially if grasses become dominant.

Introduction

The total area of rangelands in the Sudan is 117.6 million hectares Forage produced from natural pasture represent 86.6% of national animal feed requirements (Ministry of Agriculture, 2005). The total amount of the livestock is estimated by 40, 48, 41 and 3 million of cattle, sheep, goat and camels respectively (AOAD, 2003). This large amount of livestock belongs mostly to traditional pastoral production system and rose mainly on the pasture. According to Africover (2003) the pasture areas in the Sudan cover 96% of the rangelands. Nutritive quality of range varies from area to others, between seasons and growing stages. The potential of any feed to support animal production depend on the quality consumed by the animal and extend to which the feed meets energy, protein, minerals and vitamin requirement (Minson, 1990). Cellulose and hemicellulose's in forage represent the main source of energy to ruminant (Merkel *et al.*,., 1999). In many cases determination of ADF and crude protein is sufficient to give an adequate assessment of forage quality. Nutritive value of the pasture grasses varies significantly due to the seasonality of rainfall and periodic drought events.

There are many areas in Sudan characterized by their natural pasture and livestock density, Butana is one of those areas. Animal kept in Butana is major and most important source for majority population income.

The objective of this study was to evaluate the nutritive value of some pasture grasses and forbs from Butana (eastern Sudan) during early and late rainfall season in terms of chemical composition and minerals conent (macro and micro mineral) and *in vitro* digestibility.

Materials and Methods

Samples (grasses and forbs) were collected from Butana, during early season of rainfall (July 2007), and late season of rainfall (September 2007).Butana is located in the Sudanese Sahel zone, boundared by the River Nile from the west, Blue Nile, River Atbara, Kassala and Gedarif railway as eastern and southern limits.

Fresh samples of forbs (*C.kotschyi, I.oblongfolia, R.patulla, D.muricata, A.viridis,C.olitorius,P.bicolyculata,T.terrestris, B.erecta, T.portulacstrum* and *I.kordofanum*) and grasses (*R.exaltata, D.annulatum, E.colonum, C.biflorus, S.acromelaena, and C.rotundus,*) were harvested, weighed and stored in cloth bags for air drying. Then thoroughly mixed, oven dried and ground in hummer mill with stainless steel knives (Glen Creston, Stanmore, and Type D.F.H. 48) to pass through a 1 mm screen. Samples were packed in plastic bag for further chemical analysis. Proximate analysis for chemical components, crud protein, ether extract, crud fiber and ash were determined according to AOAC (1990).macro minerals calcium, magnesium, and phosphorus were determined by spectrophotometer. Potassium and sodium were determined by flame photometer. Trace minerals (iron, copper, manganese and zinc) were determined by atomic absorption spectrophotometer 2380, according to Elemer (1982). For gas production parameters samples of grasses and forbs (200 mg DM) were incubated *in vitro* with rumen fluid in calibrated glass syringes of 100 ml following the procedures of Menke and Steingass (1988). Rumen fluid was obtained from two fistulated steers fed alfalfa hay *ad libitum* and 1Kg each of concentrate mixture. Gas production was recorded before incubation (0) and 3, 6, 12, 24, 48, 72 and 96 h after incubation. Total gas values were corrected for blank. Cumulative gas production data were fitted to the model of Ørskov and McDonald (1979) using the following equation.

$$p = a + b\,(1\text{-}\exp^{-c\,t})$$

Where:
p:represents gas volume (ml) at time t,
a: the gas produced from soluble fraction (ml),
b: the gas produced from insoluble but fermentable fraction (ml)
(a+ b): the potential gas production (ml), and
c: the rate constant of gas production during incubation (ml h^{-1}).

Statistical analysis

The experimental design was Completely Randomized (Steel and Torrie, 1980). Data were subjected to analysis of variance using statistix 8.0. Means were compared using least significant difference (LSD).

Results

Crude fiber contents of grasses and forbs were varied significantly (P<0.001).The mean value ranged from 25.06% to 38.3 at early rain fall and ranged from 29.03% to 44.00% in late rainfall season(Table 1). Crude fiber contents in all grasses and forbs were significantly (P<0.001) increased at late stage(Table 2). CP contents were varied significantly (P<0.05) among grasses and forbs species, the values were ranged from 8.77% to 23.15% at early stage and from 4.94% to 20.28% at late stage. For all grasses and forbs CP contents in early stage were higher significantly (P<0.05) than late stage and higher in forbs compared to grasses species Table (2). Ether Extract in grasses and forbs species ranged from 0.56% to 2.25% and from 0.41% to 1.37 in early and late maturity respectively Table 2. In contrast to CF the ether extract contents were significantly (P<0.001) decreased at late stage of maturity.

Ash contents were more or less tended to increase with maturity in some grasses and forbs species, in early season ranged between 5.35% and 21.50% and from 7.95% to 22.15 in late rainfall season (Table 2). The average content of the Calcium and phosphorus in the grasses and forbs species at early and late rainfall season in Butana were given in (Table 3). Calcium contents in most species were reduced significantly (P<0.01) with maturity, in contrast P contents were increased at late rainfall season. Fords accumulate more Ca than grasses. Magnesium contents at early and late season in both grasses and forbs were approximately similar (Table 4)., however forbs having higher Mg contents than grasses, the lowest Mg level was observed in *S.acromelaena* 0.8 g/kg and D.annulatum 0.4g/kg at early and late season respectively. Sodium tended to increased while Potassium decreased with maturity (Table 4).

Copper and manganese in grasses and forbs species samples collected at early and late rainfall season from Butana were shown in (Table 5). Both copper and manganese in most species were higher significantly (P<0.001) in late than early maturity stage. Similar to copper and manganese, Iron and Zinc contents were increased significantly (P<0.001) with maturity (Table 6) especially Fe which is accumulated up to toxic level above 1000 mg/kg DM in most of the species.

The kinetics of the in vitro gas production of plants pasture species at early and late rainfall season were presented in (Table 7) and (Table 8). Wide variations in gas volume from soluble fraction (a), insoluble but fermentable fraction (b), potential gas volume (a+b) and gas production rate (c), among the different pasture species were observed. Gas volumes (ml) produced from soluble fraction (a) of pasture species were varied from 1.83 to 7.94 ml at early and-0.15 to 3.60 at late rainfall season. The gas volumes produced from soluble fraction (a) were significantly (P<0.05) decreased at late rainfall season in most plant pasture species. The gas volumes (ml) produced from in soluble but degradable fraction (b) of pasture species ranged from 12.29 to 58.03 ml at early and from 11.45 to 105.73 at late rainfall season. Similar to fraction (a) gas volume produced from insoluble but degradable fraction (b) were decreased significantly (P<0.05) in most of plant pasture species. Gas production constant rates (ml/h^{-1}) fraction (c) of pasture species were varied from 0.0027 to 0.030 at early and from 0.0060 to 0.0340 at late rainfall season. In most of plant pasture species gas production rate fraction (c) were tended to increase at early season.

The potential gas volume (ml) fraction (a+b) ranged from 16.14 to 62.63 ml at early and from 12.26 to 110.01at late rainfall season. At both early and late rainfall season there was no significant variations due to the species, the potential gas volumes (a+b) were decreased in most of plant pasture species at late rainfall season.

Table (1) chemical composition (Dry Matter and Crude fiber) of some natural pasture plant in Butana in early and late rainfall season.

Species	**DM%**			**CF%**		
	Early	late	Pe	early	Late	Pe
P. bicolyata	92.42^{mn}	95.13^{bcde}	* **	38.30^{de}	41.71^{bc}	***
R. patulla	92.17^{n}	94.31^{fgh}	* **	25.32^{kl}	31.07^{i}	***
A. viridis	92.52^{lmn}	94.38^{efg}	* **	26.04^{kl}	37.16^{ef}	***
D. muricata	93.10^{klm}	95.49^{ab}	* **	29.52^{j}	41.00^{bc}	***
T. portulacastrum	94.58^{def}	95.35^{abcd}	NS	31.15^{i}	42.03^{b}	***
C. kotschyi	93.23^{jkl}	95.24^{bcd}	* **	28.77^{j}	32.35^{hi}	***
I. kordofana	93.44^{ijk}	95.35^{abcd}	* **	28.99^{j}	36.08^{f}	***
C. rotundus	93.02^{klm}	94.34^{efg}	* **	36.74^{f}	39.00^{c}	***
I. oblongfolia	93.98^{fghij}	94.68^{cdef}	NS	34.32^{g}	40.70^{c}	***
B. erecta	93.44^{ijk}	95.42^{abc}	* **	32.49^{h}	39.35^{c}	***
C. biflorus	93.48^{ijk}	95.35^{abcd}	* **	28.59^{j}	38.65^{c}	***
D. annulatum	93.61^{ghijk}	95.35^{abcd}	* **	36.45^{f}	41.21^{bc}	***
E. colonum	93.53^{hijk}	94.17^{fghi}	NS	36.20^{f}	44.00^{a}	***
R. exltata	93.10^{klm}	95.23^{bcd}	* **	32.63^{h}	41.03^{bc}	***
S. acromelaena	94.60^{def}	96.10^{a}	* **	26.19^{kl}	38.39^{de}	***
C. olitorius	92.39^{mn}	94.15^{fghi}	* **	26.47^{k}	32.24^{hi}	***
T. terrestrist	95.28^{bcd}	95.90^{ab}	NS	25.06^{l}	29.03^{j}	***
SE	0.28			0.46		

^{abc} mean on the same column with different superscripts different significantly at P <0.001.
SE= standard error
Pe= period effect
CF= crude fiber
NS= No Significant effect
*** P<0.001
# Grasses species

Table (2) chemical composition (Crude protein%, Ether Extract% and ash%) of some natural pasture plant in Butana in early and late rainfall season

[abc] mean on the same column with different superscripts different significantly at P <0.001.

NS= No Significant effect

	CP%			**EE%**			**Ash%**		
	early	late	Pe	Early	late	Pe	early	late	Pe
P. bicolyata	18.21^{f}	12.43^{j}	***	1.58^{cd}	0.51^{opq}	***	10.64^{mno}	18.14^{de}	NS
R. patella	21.34^{c}	15.42^{gh}	***	1.38^{def}	0.751^{mno}	***	20.96^{ab}	21.22^{ab}	NS
A. viridis	19.25^{e}	14.20^{i}	***	1.69^{bc}	0.85^{klmn}	***	18.32_{cde}	12.25^{klm}	NS
D. muricata	11.23^{k}	9.11^{mno}	***	0.75^{lmno}	0.68^{mn0p}	NS	17.45^{ef}	18.18^{de}	NS
T. portulacastrum	13.08^{j}	8.62^{op}	***	0.56^{opq}	0.54^{opq}	NS	20.35^{ab}	22.15^{a}	NS
C. kotschyi	9.68^{mn}	7.06^{q}	***	1.19^{fghi}	0.89^{jklm}	***	19.65^{bcd}	20.10^{bc}	NS
I. kordofana	22.13^{c}	16.12^{g}	***	1.32^{efg}	0.64^{n0pq}	***	15.90^{fgh}	13.86^{ijk}	NS
C. rotundus	13.16^{j}	8.50^{op}	***	1.06^{hijk}	0.63^{nopq}	***	10.21^{nop}	10.12^{nop}	NS
I. oblongfolia	25.11^{a}	20.28d	***	1.44^{de}	0.48^{pq}	***	8.75^{pq}	7.98^{q}	NS
B. erecta	17.60^{f}	12.81^{j}	***	1.48^{cde}	1.05^{hijkl}	***	5.35^{ghi}	16.45^{efg}	NS
C. biflorus	13.16^{j}	9.77^{lm}	***	1.12^{ghij}	0.89^{jklm}	NS	16.47^{efg}	8.15^{q}	NS
D. annulatum	10.69^{kl}	7.85^{pq}	***	1.29^{efgh}	0.89^{jklm}	***	12.26^{klm}	9.27^{opq}	NS
E. colonum	8.77^{nop}	6.95^{q}	***	0.60^{nopq}	0.62^{nopq}	NS	13.14^{jkl}	16.06^{fgh}	NS
R. exltata	9.41^{mno}	4.94^{r}	***	1.91^{b}	0.50^{pq}	***	12.19^{klm}	7.95^{q}	NS
S. acromelaena	14.70^{hi}	9.67^{mn}	***	0.93^{jkl}	0.41^{pq}	***	21.50^{ab}	14.54^{hij}	NS
C. olitorus	23.12^{b}	18.51^{ef}	***	1.52^{cde}	1^{ijk}	***	12.45^{klm}	11.52^{lmn}	NS
T. terrestris	15.93^{g}	14.92^{hi}	***	2.25^{a}	1.37^{def}	***	15.16^{ghi}	20.18^{c}	NS
SE	0.34			0.09			0.16		

*** P<0.001

SE= standard error

Pe= period effect

CP= Crude Protein, EE= Ether Extract

#=Grasses species

Table (3) Macro mineral content g/kg of some natural pasture plant in

	Ca			P		
	early	Late	Pe	early	Late	Pe
P. bicolyata	10.4^{cd}	7.6i	***	$3.8^{abcdefg}$	4.0^{abcdef}	NS
R. patella	11.0^{bc}	8.3^{hi}	***	$3.8^{abcdefg}$	4.9^{a}	NS
A. viridis	10.9^{bc}	9.7^{de}	***	2.2^{hijk}	$3.8^{abcdefg}$	NS
D. muricata	10.7^{bc}	9.3^{efg}	***	4.1^{abcde}	$3.9^{abcdefg}$	NS
T. portulacastrum	9.2^{efg}	9.5^{ef}	NS	2.3^{hijk}	4.0^{abcdef}	NS
C. kotschyi	7.6^{i}	5.1^{k}	***	3.2^{cdefgh}	0.9^{l}	NS
I. kordofana	4.2^{l}	2.8^{mn}	***	$3.0^{defghij}$	5.1^{a}	NS
*C. rotundus**	4.4^{kl}	1.9^{o}	***	1.3^{kl}	$3.1^{cdefghi}$	NS
I. oblongfolia	11.4^{b}	8.6^{gh}	***	1.8^{ijkl}	2.9^{efghij}	NS
B. erecta	8.6^{gh}	8.2^{hi}	NS	4.3^{abcd}	4.1^{abcde}	NS
*C. biflorus**	3.0^{m}	0.9^{p}	***	2.6^{ghijk}	4.6^{ab}	NS
*D. annulatum**	2.8^{mn}	2.0^{no}	NS	$3.3^{bcdefgh}$	4.4^{abc}	NS
*E. colonum**	2.8^{mn}	2.1^{no}	NS	2.7^{fghi}	$3.8^{abcdefg}$	NS
*R. exltata**	2.3^{mno}	1.0^{p}	***	2.3^{hijk}	$3.9^{abcdefg}$	NS
*S. acromelaena**	1.5^{op}	0.9^{p}	NS	2.4^{hijk}	4.1^{abcde}	NS
C. olitorus	8.8^{fgh}	7.6^{j}	***	2.2^{hijk}	$3.8^{abcdefg}$	NS
T. terrestris	13.3^{a}	7.7^{i}	***	1.7^{jkl}	2.7^{fghi}	NS
SE	0.02			0.04		

Butana in early and late rainfall season

^{abc} mean on the same column with different superscripts different significantly at P <0.05

*** P<0.001

SE= stander error

Pe= period effect

NS= No Significant effect

Ca= Calcium, P= Phosphorus.

* =Grasses species

Table (4): Macro mineral content g/Kg of some natural pasture plant in Butana in early and late rainfall season.

	Mg			**Na**			**K**		
	early	Late	Pe	early	late	Pe	early	Late	Pe
P. bicolyata	2.0^{fghi}	2.1^{fgh}	NS	0.2^{o}	1.9^{abc}	***	9.0^{ij}	8.5^{jk}	NS
R. patella	2.7^{cde}	2.5^{def}	NS	0.3^{no}	0.9^{hijklm}	***	7.3^{lm}	6.7^{m}	NS
A. viridis	4.1^{a}	3.3^{b}	***	0.6^{mno}	1.8^{bcd}	***	12.6^{e}	11.2^{f}	***
D. muricata	3.2^{b}	3.0^{bcd}	NS	0.8^{ijkm}	1.9^{abc}	***	14.5^{d}	14.1^{d}	NS
T. portulacastrum	1.9^{ghij}	2.9^{bcde}	NS	$0.9^{ghijklm}$	1.6^{bcde}	***	11.3^{f}	9.9^{ghi}	***
C. kotschyi	1.8^{hij}	0.7^{nop}	***	$0.9^{ghijklm}$	$1.1^{fghijkl}$	NS	14.3^{d}	13.9^{d}	NS
I. kordofana	3.2^{bc}	1.9^{ghij}	***	$0.9^{ghijklm}$	1.3^{efghi}	NS	18.8^{ab}	10.1^{gh}	***
*C. rotundus**	2.0^{fghi}	1.4^{jklm}	NS	0.6^{klmno}	1.2^{efgij}	***	8.8^{j}	7.0^{n}	***
I. oblongfolia	2.9^{bcde}	1.6^{hijk}	***	$1.1^{efghijk}$	1.4^{defg}	NS	11.3^{f}	10.9^{fg}	NS
B. erecta	2.0^{fghi}	2.4^{efg}	NS	0.5^{mno}	1.3^{efghi}	***	12.8^{e}	10.9^{fg}	***
*C. biflorus**	1.3^{klm}	0.7^{nop}	***	0.6^{lmno}	1.5^{bcdef}	***	9.3^{hij}	9.3^{hij}	NS
*D. annulatum**	$1.o^{lmno}$	0.4^{p}	***	0.3^{no}	1.3^{efghi}	***	8.4^{jk}	7.7^{kl}	NS
*E. colonum**	0.9^{mnop}	0.7^{nop}	NS	0.5^{mno}	$0.9^{ghijklm}$	NS	7.8^{kl}	7.3^{lm}	NS
*R. exltata**	1.5^{ijkl}	1.1^{lmn}	NS	0.6^{mno}	1.9^{bc}	***	3.9^{o}	3.4^{o}	NS
*S. acromelaena**	0.8^{mnop}	0.5^{op}	NS	0.7^{jklmn}	1.3^{defgh}	***	8.5^{jk}	6.9^{lm}	***
C. olitorus	1.9^{ghij}	0.9^{mnop}	***	$0.9^{ghijklm}$	2.4^{a}	***	17.1^{b}	19.6^{a}	***
T. terrestris	1.9^{ghij}	1.1^{klmn}	***	1.5^{cdef}	2.0^{ab}	***	18.3^{b}	9.2^{hij}	***
SE	0.02			0.02			4.83		

^{abc} mean on the same column with different superscripts different significantly at P <0.05.
SE= standard error
Pe= period effect
*** P<0.001
NS= No Significant effect
Mg= Magnesium, Na= Sodium, K= Potassium.
* =Grasses species

Table (5): Micro mineral content (mg/kg) of some natural pasture plant in Butana in early and late rainfall season.

	Cu			Mn		
	early	late	Pe	early	late	Pe
P. bicolyata	0.73[mn]	1.64[kl]	***	30.76[i]	54.17[e]	***
R. patella	0.85[lmn]	1.14[lm]	NS	31.16[hi]	52.30[e]	***
A. viridis	0.58[mn]	1.001[m]	NS	22.57[j]	58.56[de]	***
D. muricata	0.69[mn]	1.29[klm]	NS	37.89[fg]	64.69[cd]	***
T. portulacastrum	1.35[klm]	3.38[gh]	***	56.06[e]	85.30[a]	***
C. kotschyi	2.71[hij]	3.52[gh]	NS	63.37[cd]	82.26[ab]	***
I. kordofana	7.64[c]	12.37[a]	***	31.06[hi]	67.51[c]	***
C. rotundus	3.11[hi]	4.90[f]	***	17.04[jkl]	31.60[ghi]	***
I. oblongfolia	6.19[e]	7.31[cd]	***	10.13[m]	19.51[jk]	***
B. erecta	1.02[lm]	2.48[ij]	***	33.57[ghi]	76.96[b]	***
C. biflorus	1.26[klm]	3.08[hi]	***	21.85[j]	37.32[fgh]	***
D. annulatum	0.64[mn]	4.12[fg]	***	37.35[fgh]	64.69[cd]	***
E. colonum	0.09[n]	1.08[lm]	***	15.51[klm]	22.24[j]	***
R. exltata	2.06[jk]	2.49[ij]	NS	11.38[lm]	18.23[jk]	***
S. acromelaena	3.17[hi]	6.72[de]	***	18.06[jk]	29.18[i]	***
C. olitorus	7.10[cd]	9.48[b]	***	29.55[i]	42.04[f]	***
T. terrestris	4.72[f]	6.09[e]	***	11.74[lm]	11.73[lm]	NS
SE	0.29			2.23		

[abc] mean on the same column with different superscripts different significantly at P <0.001
*** P<0.001
SE= standard error
Pe= period effect
NS= No Significant effect
Cu= Copper, Mn= Manganese.
#= Grasses species.

Table (6): Macro mineral contents (mg/kg) of some natural pasture plant in Butana in early and late rainfall season.

	Fe			Zn		
	early	Late	Pe	early	late	Pe
P. bicolyata	579^{jkl}	815^{ghi}	***	22.34^{fgh}	34.29^{e}	***
R. patella	518^{kl}	592^{jkl}	NS	22.45^{fgh}	43.17^{cd}	***
A. viridis	487^{klm}	792^{hi}	***	19.66^{fghijk}	59.46^{a}	***
D. muricata	340^{no}	771^{hi}	***	19.68^{fghijk}	46.25^{c}	***
T. portulacastrum	803^{hi}	1499^{c}	***	24.22^{fg}	55.20^{ab}	***
C. kotschyi	109^{p}	220^{op}	NS	13.68^{klm}	22.45^{fgh}	***
I. kordofana	1129^{e}	1741^{b}	***	21.36^{fghi}	52.60^{b}	***
C. rotundus	1032^{ef}	1762^{b}	***	12.70^{lm}	32.38^{e}	***
I. oblongfolia	103^{p}	365^{mn}	***	15.27^{ijklm}	22.49^{fgh}	***
B. erecta	771^{hi}	1443^{cd}	***	14.32^{jklm}	25.75^{f}	***
C. biflorus	954^{fg}	1358^{cd}	***	18.01^{ghijkl}	37.22^{de}	***
D. annulatum	720^{ij}	1925^{a}	***	20.22^{fghij}	36.30^{e}	***
E. colonum	803^{hi}	1339^{d}	***	19.29^{ghijk}	32.12^{e}	***
R. exltata	768^{hi}	1152^{e}	***	17.68^{hijkl}	43.90^{c}	***
S. acromelaena	619^{jk}	1447^{cd}	***	18.83^{ghijkl}	45.85^{c}	***
C. olitorus	474^{lmn}	1339^{d}	***	14.41^{jklm}	55.77^{ab}	***
T. terrestris	517^{kl}	899^{fgh}	***	9.18^{m}	58.55^{ab}	***
SE	50.98			2.24		

^{abc} mean on the same column with different superscripts different significantly at P <0.001
SE= standard error
Pe= period effect
NS= No Significant effect
*** P<0.001
Fe= Iron, Zn= Zinc.
*= Grasses species.

Table (7): In vitro gas production parameters (a) and (b) on pasture plants (ml/200mgDM) at early and late rainfall season in Butana.

species	A			b		
	early	Late	Pe	early	late	Pe
P. bicolyata	2.66hijk	2.16^{jklmn}	NS	14.77cd	24.91cd	NS
R. patulla	$2.43^{hijklmn}$	2.29^{ijklmn}	NS	17.07cd	27.66cd	NS
A. viridis	2.97efg	1.99lmn	***	23.55cd	18.09cd	NS
D. muricata	1.96mn	0.99o	***	35.91bcd	13.34cd	NS
T. portulacastrum	3.85de	0.81o	***	12.29d	11.45d	NS
C. kotschyi	2.54^{hijklm}	2.02lmn	NS	22.18cd	31.61bcd	NS
I. kordofana	7.94a	4.25cd	***	23.69cd	105.73a	***
*C. rotundus**	6.14b	3.57ef	***	15.70cd	13.88cd	NS
I. oblongfolia	2.09klmn	1.07o	***	21.03cd	16.53cd	NS
B. erecta	4.66c	2.59hijkl	***	58.03b	35.85bcd	NS
*C. biflorus**	1.83n	2.13^{jklmn}	NS	20.01cd	32.62bcd	NS
*D. annulatum**	4.57c	2.96fgh	***	20.79cd	20.35cd	NS
*E. colonum**	3.49efg	2.73hij	***	43.23bc	20.22cd	NS
*R. exltata**	0.07p	-0.15p	NS	18.58cd	15.72cd	NS
*S. acromelaena**	$2.40^{hijklmn}$	0.94p	***	60.46b	25.15cd	***
C. olitorus	6.67b	3.60e	***	37.38bcd	34.44bcd	NS
T. terrestris	3.46efg	2.91ghi	NS	31.49bcd	15.75cd	NS
SE	0.16			7.55		

^{abc} mean on the same column with different superscripts different significantly at P <0.001.
SE= standard error
Pe= period effect
NS= No Significant effect
*** P<0.001
*= Grasses species

Table (8): In vitro gas production parameters (a+b) and (c) on pasture plant (ml/200mgDM) at early and late rainfall season in Butana

Species	a + b			c		
	Early	Late	Pe	Early	Late	Pe
P. bicolyata	17.43cde	27.07cde	NS	0.0243bc	0.0070^{fghij}	***
R. patella	19.50cde	29.95cde	NS	0.0160de	0.0060ghij	***
A. viridis	26.52cde	20.07cde	NS	0.0087^{efghij}	0.0107ghij	NS
D. muricata	37.57bcde	14.33de	NS	0.0087^{efghij}	0.0240bc	***
T. portulacastrum	16.14de	12.26e	NS	0.0203cd	0.0297ab	***
C. kotschyi	24.72cde	33.63bcde	NS	0.0107^{efghi}	0.0063ghij	NS
I. kordofana	31.64cde	110.01a	***	0.0147def	0.0133^{defg}	NS
C. rotundus	21.85cde	17.45cde	NS	0.0133^{efghi}	0.0133d^{efg}	NS
I. oblongfolia	23.12cde	17.60cde	NS	0.030ab	0.0340a	NS
B. erecta	62.63b	38.45bcde	NS	0.0027j	0.0060ghij	NS
C. biflorus	21.84cde	34.74bcde	NS	0.0243bc	0.0073^{fghij}	***
D. annulatum	25.37cde	23.31cde	NS	0.0157de	0.0097^{efghij}	***
E. colonum	46.71bc	22.94cde	NS	0.0037ij	0.0070^{fghij}	NS
R. exltata	18.65cde	15.57de	NS	0.0272abc	0.0287ab	NS
S. acromelaena	62.85b	26.09cde	***	0.0053hij	0.0120^{efgh}	NS
C. olitorus	44.05bcd	38.03bcde	NS	0.0097^{efghij}	0.0083^{efghij}	NS
T. terrestris	34.95bcde	18.67cde	NS	0.0143def	0.0297ab	***
SE	7.64			-1.96		

^{abc} mean on the same column with different superscripts different significantly at P <0.001.
SE= standard error
Pe= period effect
NS= No Significant effect
*** P<0.001
*= Grasses species

Discussion:

Curde protei increased with maturity in both lower and upper limits of the range for the pasture grasses and forbs Kaya *et al.,* (2004). This will be due to rapid increase in structural cell wall carbohydrates with advance in maturity, Bayble *et al.,* 2007. Also CF increased over time may be partially due to animal selection behaviour, Titemeyer and Loest 2001. CPcontents in grasses species ranged between 14.7% to 8.77% and 9.67 to 4.94% in early and late stage respectively, the lower limits were supported by Bakshi *et al.,* (2005) who found the range between 8.3% and 4.7%, and the upper limits were higher than that (11.9% to 5.5%) reported by Jurez *et al.,*., (1999). The highest grasses CP content was 14.4% at early stage given by *S.acromelaena* species and the lowest value was 4.94% (*R.exltata*) at late rainfall season. This result is inconsistent with findings of Bable *et al.,* (2007) who found 14.13% and 7.77% CP of grasses at early and late stage respectively. Also Mlay *et al.,* (2006) reported the range from 5% to 3.8% CP content in late stage. In leguminous species the highest CP content value was 25.11% (*I.oblongfolia*), while the lowest value was 12.43%, this result is supported by Valarini and Possenti (2006) who reported 16.7% to 24.3% CP and it is comparable with findings of Bayble *et al.,(*2007) who found 19.27% and 13.73% CP contents at early and late maturity respectively. It is obviously for both grasses and forbs species CP contents decreased with maturity Kaya *et al.,* 2004. This is inconsistent with Bolale *et al.,* 2008 and Bayble *et al.,* (2007). Normally forbs were ranked first when compared to grasses in respect of CP contents, while the opposite was occurred in terms of CF contents. According to CP contents at early stage the pasture, forbs and grasses species were ranked asfollow: *I.oblogfolia>C.olitorus>I.kordofana>R.patulla>A.viridis>P.bicolyata>B.erecta>T.terrestris>S.acromelaena>C.biflorus=C.rotundus>T.portulacastrum>D.muricata>D.annulatum>C.kotschyi> R.exltat> E.colonum.*

CP values were ranged from 8.77% to 23.15% at early stage, these values were ranged from very good to fair enough for animal nutrition which may not need supplements, and from 4.94% to 20.28% at late stage which is reduced to fair and poor that will need protein supplements at late rainfall season particularly when animal fed grasses. Forbs accumulate over twice the amount of Ca as grasses and more than adequate to meet animal requirement 6 g/kg DM (NRC, 2000), this result is inconsistent with findings of Greene (1999) and Juknevicius and Sabiene (2007). Ca levels were decreased with maturity below the nutritional requirements in all grasses, while most of forbs having sufficient levels. Similarly more or less forbs accumulated more Cu compared to the grasses and all of them were deficient in it 10mg/kg DM (NRC, 2000). Most of the plant species were sufficient in Mg level for animal requirement 1.5 g/kg DM (NRC, 2000) but to some extends some grasses were lack in Mg, (*S. acromelaena*, *E.colonum* and *D.annulatum*). The result revealed slight reduction in Mg levels in the pasture in advance maturity. Na element being adequate at the late season 1g/kg while K element was tended to be sufficient 11g/kg through out the season with sever deficient in grass species *R. exltata* 3.9 and 3.4 g/kg at early and late rainfall season respectively this is supported by findings of McDowell (1996). Zn element in both forbs and grasses increased with advance maturity to meet animal requirement 30mg/kg DM, similarly Mn and Fe elements were increased in the late stage, these elements were sufficient through out the season in most pasture species 25 and 50 mg/kg DM respectively. Gas volume produced during the fermentation process directly proportion to the amount of the nutrients. In most of pasture species the potential gas production decreased with maturity, which might be due to increase in structural cell wall carbohydrate particularly ADF. This result is inconsistent with Kamalak *et al.,* (2005).

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