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NUTRIENTS AND ANTI-NUTRIENTS ANALYSIS OF GUAR (*Cyamopsis tetragonoloba*) FORAGE GENOTYPES

E.O. Amasaib[1], Ibrahim, R. A.B.H[1], Abdel Wahab H. Abdalla[2]
[1]Department of Animal Nutrition, Faculty of Animal Production,
University of Khartoum, Khartoum, Sudan
[2]Department of agronomy, Faculty of Agriculture,
University of Khartoum, Sudan
E-mail: samaniamasaib@gmail.com (**Corresponding Author*)

Abstract: The experiment was aimed to study the effect of genotype on the nutritive value of Guar (*Cyamopsis tetragonoloba*). Seven guar genotypes were used in this study namely: L10, $L5_3$, Gm1, Gm10, Gm3, Gm6 and Gm7. The results revealed that the genotypes had no significant effect on the CP content. The highest value for CP was recorded for genotype Gm1, while the least value was attained for genotype Gm3. On the other hand, genotype caused highly significant effect ($P<0.01$) on the digestibility with the highest value recorded for the genotype Gm10, and the least value was recorded for the genotype $L5_3$. Also the ash content was found to be positively affected by genotypes. Genotypes had a highly significant effect ($P<0.01$) on tannin and saponin content. The results showed that genotype had a highly significant effect on Ca and Mg content ($P<0.01$), and non significant K and P content. Correlation between treatments revealed that the CP was positively correlated with digestibility, but with no significant differences, while the tannin content was negatively and significantly correlated with digestibility ($P<0.05$).
Keywords: *Cyamopsis tetragonoloba*, Animal nutrition, Mineral, Nutritive value

Introduction

The range condition in Sudan is deteriorating due to over grazing, drought and expansion of rain fed agriculture at the expense of rangelands. This means that there is a shortage in feed supply for livestock in the country. There for, the irrigated forage pasture are needed to bridge the gap between forage supply and animal feed demands.

Forage legumes offer several advantages to tropical farming system. Guar is grown principally for its green fodder and for the pods that are used for food and feed. Guar is a new crop in Sudan, and is grown commercially in limited scale near Singa, Blue Nile for seed processing into flour. The improvement of forage legume quality may be through genetic improvement. Like selection for decreased fiber concentration or increased rate or extent of fiber digestion (Jung and Allen, Decreasing fiber concentrations of forages can increase dry

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matter intake (Mertens, 1973) and increasing fiber digestibility of maize that can increase dry matter intake and rate of gain for steers (Roth and Klopfenstein, 1987). Improvements in forage genetics coupled with improved of rumen models and forage analyses are helping to provide higher quality forages and understanding of how to capture their full value in the diet. High-forage intakes are possible by producing and feeding higher-quality, lower-NDF and NDF) forages. The classic multi-forage meta-analysis by Oba and Allen (1999) suggests that a one-percentage point increase in NDF digestibility can increase daily dry matter intake by 0.37 lb., resulting in a daily increase of 0.55 lb. of 4% fat-corrected milk. There for, this study aimed to high light the best quality genotype of Guar (Cyamopsis tetragonoloba) in the condition of tropic and sub tropic climate, Sudan.

Material and methods

Study site and sample collecion

The study was held on December 2012 at the faculty of Animal Production, University of Khartoum, Sudan. Seven genotypes of guar (*Cyamopsis tetragonoloba)* were used in this study. The Forages were collected from a field trial conducted at faculty of Agricultural University of Khartoum, Sudan.

Chemical analysis

Dray matter content, Ash content, where determined according to AOAC (1984) method.
Crude protein determined by using Kjeldahal method according to AOAC (1984).

Two stage Digestibility

Dry matter digestibility of the samples was determined using the procedure 'two-stage *in vitro'* described by Tilly and Terry (1963).

Anti nutritional factors determination:

Tannin determination

Feed and faecal samples were analysed for their anti-nutritional factors or secondary metabolites (Howe and Westthly 1988), which were assayed thus: Saponin was done by method of strong (1979) Tannin was determined by protein precipitation method according to Hagerman and Butter, (1983)

Quantitative estimation of tannin was carried out using the modified vanillin-HCL method of price et al. (1978). Absorbance was read on spectrophotometer (Jenway 6305 UV/Vis spectrophotometer), and the concentration of the condensed tannin was determined from the standard curve.

Minerals determination:

To determine the macro mineral, samples from seven genotypes of guar were used. The ground samples were ashed at 4500 C for four hours in a furnace. The cooled ash was digested using 20% HNO3 on a hot plate to boiling and the digested samples were filtered through a filter paper. In the filtrate, phosphorous (P) was determined by spectrophotometer according to Murphy and riley (1962). Potassium (K), calcium (Ca) and magnesium (Mg) by atomic absorption according to Houba et al. (1989).

Statistical analysis:

The experiment was conducted following the Completely Randomize Design (C.R.D).the data were subjected to Analysis of variance and correlation using 0.8 statistical programs.

Results

Table (1) shows the effect of genotypes on the CP, Digestibility and Ash content of seven genotypes of *Cyamopsis tetragonoloba* forage. The data showed that genotype had no significant effect on CP content. Although the effect of genotype on the CP content did not reached the level of significance, but the genoype Gm1 recorded the lowest value followed by L10, Gm6, Gm7, Gm10, $L5_3$, and Gm3 respectively.

Concerning the effect of genotype on the digestibility, the data revealed that genotype had a highly significant influence (P<0.01). In this connection, genotype Gm10 obtained the highest value fallowed by Gm1, Gm7, Gm3, $L5_3$, L10, and Gm6 respectively.

The same trend was observed concerning the effect of genotype on the Ash content, the data revealed that genotype had a highly significant effect (P<0.01) on the Ash content, with the highest value recorded for $L5_3$, L10, Gm3, Gm1, Gm7, Gm6, and Gm10 respectively.

The effect of genotype on the tannin content in seven genotypes of *Cyamopsis tetragonoloba* forage was illustrated in table (2). The data revealed that genotype had a highly significant influence (P <0.01) on the tannin content with the highest value recorded for the genotype Gm1 followed by Gm6, Gm3, $L5_3$, Gm7, L10, and Gm10 respectively. Table (2) outlined the effect of genotype on the saponin content, the results showed that genotypes had a highly significant effect (P>0.01) on saponin content. Among the seven different genotypes, genotype Gm7 secured the lowest value followed by Gm10, Gm3, Gm6, $L5_3$, Gm1, and L10 respectively. In addition to that no significant difference was observed among genotype Gm10 and Gm7.

Table (3) illustrates the effect of genotypes on the macro minerals content (Ca, Mg, K, and P) of *Cyamopsis tetragonoloba (*Guar). Ca content was affect by genotype (P<0.01), with highest value recorded for the genotype $L5_3$ followed by Gm1, L10, Gm10, Gm7 and Gm3 respectively. The same trend was found concerning the effect of genotype on Mg content for these six genotypes which was found to be highly significant (P> 0.01), with the highest value recorded for the genotype Gm7 followed by Gm1, $L5_3$, Gm3, L10 and Gm10 respectively, with no significant difference among Gm7 and Gm1.

In respect to the effect of genotype on K and P content for these six genotypes, there was no significant difference among all genotypes with least value recorded for the genotype Gm3 followed by Gm10, $L5_3$, Gm7, L10 and Gm3 in K content respectively, and for the genotype $L5_3$ followed by Gm7, Gm3, Gm10, L10, and Gm1in P content respectively.

The correlations between the CP and digestibility, CP and tannin, and among CP and saponin were illustrated in table (4). The data revealed that, there is no significant correlation between all of them.

The data also showed significant correlations among digestibility and tannin (P>0.05).While no significant correlation between digestibility and saponin (P<0.05).The results also revealed no significant correlation between tannin and saponin (P<0.05).

Table (1) Effect of the genotypes on CP, Digestibility and Ash content of *Cyamopsis tetragonoloba* forage

Genotypes	CP%	Digestibility %	Ash%
Gm7	26.290^{a}	89.535^{c}	12.780^{ab}
Gm6	24.925^{a}	81.560^{g}	12.080^{bc}
Gm3	28.735^{a}	89.370^{d}	13.035^{a}
Gm10	27.700^{a}	91.690^{a}	11.695^{c}
Gm1	23.815^{a}	90.785^{b}	12.990^{a}
$L5_3$	27.725^{a}	89.010^{e}	13.445^{a}
L10	24.760^{a}	87.710^{f}	13.155^{a}
S E M	2.4259	0.0217	0.3129
Level of significant	NS	**	**

Means followed by the same super script in the same column are not significantly different at (0.5) level of significance.

S E M = Standard Error of Means

Level of significant : **(P>0.01) = **** **NS = not significant**

CP = Crude Protein Ash= Ash content

Dig.= digestibility

Table (2) Effect of the genotypes on Tannin and Saponin content of ***Cyamopsis tetragonoloba*** forage

Genotypes	Tannin %	Saponin %
Gm7	0.9380 [d]	0.1147 [f]
Gm6	1.3350 [a]	0.1622 [d]
Gm2	1.2510 [b]	0.1263 [e]
Gm10	0.6050 [e]	0.1151 [f]
Gm1	1.3410 [a]	0.3979 [b]
$L5_3$	1.1380 [c]	0.1989 [c]
L10	0.9320 [d]	0.7008 [a]
S E M	0.0234	2.018E-04
Level of significant	**	**

Means with different subscriptions are statistically different. Means followed by the same super script in the same column are not significantly different at (0.5) level of significance.
S E M = Standard Error of Means
Level of significant : (P>0.01) = ** NS = not significant

Table (3) Effect of the genotype on minerals content of ***Cyamopsis tetragonoloba*** forage

Genotypes	Ca%	Mg%	K%	P%
Gm7	0.0524 [d]	0.0104 [a]	2.0501 [a]	0.2361 [a]
Gm3	0.0474 [e]	9.30E-03 [c]	1.9209 [a]	0.2430 [a]
Gm10	0.0559 [c]	8.75E-03 [e]	1.9436 [a]	0.2442 [a]
Gm1	0.0625 [b]	0.0104 [a]	2.2088 [a]	0.2610 [a]
$L5_3$	0.0659 [a]	9.60E-03 [b]	2.0434 [a]	0.2313 [a]
L10	0.0568 [c]	9.15E-03 [d]	2.0689 [a]	0.2473 [a]
S E M	5.745E-04	4.082E-05	0.3001	0.0152
Level of significant	**	**	NS	NS

Means followed by the same super script in the same column are not significantly different at (0.5) level of significance.
S E M = Standard Error of Means
Level of significant: **(P>0.01) = **** **NS =not significant**

Table (4) Correlation between the crude proteins, digestibility, tannin and saponin content of ***Cyamopsis tetragonoloba*** forage

	CP	Digestibility	Tannin	Saponin
CP	1	0.239	- 0.221	- 0.438
Digestibility	0.239	1	- 0.473 *	- 0.026
Tannin	- 0.221	- 0.473 *	1	0.025
Saponin	- 0.438	- 0.026	0.025	1

* Correlation is significant at the 0.05 level (1-tailed).

Discussion

Guar meal is an interesting feedstuff due to its relatively high protein content, 40-45%. Guar was found to be not very suitable for grazing due to its hairy leaves and un palatability (Göhl, 1982). Guar is sometimes grazed to reduce the risk of bloat in ruminant.

The results indicated that the genotype had non signigacant effect on the CP of the seven Guar genotypes, although, there is slight variation in CP content between genotype Gm3 (28.735) and genotype Gm1 (23.815).These results were comparable to the results obtained by Rahul Kapoor (2014) who stated that The variety BR-99 gave significantly higher crude protein % (16.63 %) than cluster bean 2/1and BR-90. In addition to that, these results are quite in line with those of Kays et al. (2006) who reported significant differences among guar cultivars regarding protein contents. Also similar results were obtained by (QAMAR ET AL, 2014) on some summer crops. They found that Cluster bean had the highest crude protein content of 23.2 % followed by cowpea (22.6 %), lablab bean (21.6 %), and rice bean (20.1 %).

That would be able to meet the CP requirement of lactating dairy cows which is between 16.5 and 17.5 as estimated by NRC 2001, and beef cows requirement which is ranging from 7 to 19 as adopted by (Rayburn 2008) from National Research Council's Nutrient Requirement of beef cattle, 1984 and 2000.

The results of Dry matter digestibility showed highly significant effect of genotype (P< 0.01) on the digestibility among all the seven genotypes under studying revealed that 91.690 as highest value recorded for the genotype Gm10 and 81.560 as least value noted in the genotype Gm6, which is much more higher than 75.7_82.5 (Srinivas et al 2009), also similar to 83.6 recorded as in vitro true digestibility of organic matter in tropical legumes forage during their initial growth by (Ghadaki et; al 1974). It is also higher than (62.8_71.2) reported (Bhagwan Das et al 1975) in thirteen genotypes of guar.

Concerning the Ash content the results showed that The genotype had highly significant influence ($P<0.01$) on the Ash content among all seven genotypes under evaluation, which is varied from 11.695 as the least value recorded for the genotype Gm10 and 13.445 as the highest value recorded for the genotype $L5_3$. These results are quite comparable to the results obtained by Ayub (2010), they found that the differences among cultivars were significant regarding ash % age. The varieties cluster bean 2/1and BR-90 produced statistically similar ash % age (8.78) but significantly higher than BR-99 (8.3%). Significant differences among the varieties regarding the total ash % have also been reported by Lee *et al.* (1997).

Condensed tannins have traditionally been thought to reduce plant preference by digestion inhibition, because they can complex and render inactive digestive enzymes (Swain, 1979) and precipitate dietary proteins. Precipitated protein would presumably be less digestible than soluble protein and the herbivore would thus obtain inadequate dietary protein from tannin-rich plants (Swain, 1979). From the results, the highest tannin value among the seven genotypes under evaluation was noted in the genotype Gm1 which was 1.3410 and the least value was 0.6050 recorded for the genotype Gm10, with significant difference between all the genotypes ($P< 0.01$). The highest value which is 1.3410 is lower than 2.95 and 1.69 reported for cassia (Cassia rotundifoli) and lablab (lablab purpureus) respectively, and higher than 1.29 reported for ((Macroptilium atropurpureum)) by (Mupangwa et;al 2000).

The level of tannin which adversely affect digestibility in sheep and cattle is between 2% and 5% (Diagayete and Huss, 1981), Goats are known to have a threshold capacity of about 9% dietary tannin (Nastis and Malachek, 1981).

highly significant influence of genotype on saponin content ($P< 0.01$) was onbserved among the seven genotypes of Guar, the results revealed that 0.7008 was the highest value recorded for the genotype L10 and 0.1147 was the least value recorded for the genotype Gm7. The highest value which it is 0.7008 is slightly higher than 0.56 recorded in Soya bean (Glycine max), 0.3 in Sesame seed (Sesamum indicum), and much more higher than 0.1 in Oat (Avena sativa) reported by (Price et; al 1986), and these values 0.36, 0.23, 0.34, 0.37,and 0.25 recorded in Chick pea, Black gram, Moth bean, Broad beans and Peas respectively reported by (El-Adawy 2002) .

The major forage plants containing saponin include alfalfa, clovers, guar, sun flower, and lupine (Price et; al 1987).

The highest Ca value among the six genotypes under evaluation was 0.659 recorded for the genotype $L5_3$, while the least value 0.474 noted in genotype Gm3 with highly significant influence of genotype among the six genotypes (P <0.01). Mean Ca concentrations from different genotypes were above the critical value of 0.30% DM (National Research Council, 1984) for different classes of ruminants. Ca requirement of grazing ruminants is influences by animal type and level of production, age and weight of ruminants (Khan et al. (2007). Reuter and Robinson (1997) suggested Ca requirement for maintenance, growing and lactating sheep to be 1,200-2,600 mg/kg. Thus, the forage Ca values found in this study was considered under the optimum performance of ruminants. it is recommended that diets of livestock should have Ca:P ratio of about 1:1 to 2:1. Livestock will tolerate dietary Ca:P ratios of more than 10:1 without any serious effect provided the P intakes are adequate (Ternouth, 1990).

The variation between genotypes of Guar in Mg content was found to be significant (P<0.01) the least value was 0.0875 recorded for the genotype Gm10, while the highest value was 0.104 recorded for the genotypes Gm7 and Gm1, which is lower than 0.40 described as mean concentration of tropical legumes reported by (Mc Dowell et al 1974) on other hand it is higher than 0.00128 recorded in alfalfa, reported by (Markovic et al., 2007b). the differences in the content of Mg in this study with those could be partly explained by differences between forage species, level of Mg in the soil, influences of locality and climate, growth stage, proportion of leaf and stem fractions and season when herbage sampling was done (Markovic et al., 2007b).

According to Dua and Care (1995) the dietary Mg availability to stock is markedly affected by other dietary components, especially K. High dietary levels of K and N will inhibit Mg absorption from the rumen. Ca and soluble carbohydrates may respectively increase and decrease dietary Mg requirements of livestock, whereas raised dietary P levels appears to lower the requirements for both Ca and Mg (Judson and McFarlane, 1998). This value does not meet the requirement of lactating cows 0.20 to 0.25 determined by NRC 1989, and beef cows requirement 0.05 to 0.25 which determined by NRC 2000.

The resuls revealed that, There was a significant difference in the content of K among the different genotypes, although, the highest value was 2.2088 noted in the genotype Gm1, while the least value was 1.9209 noted in the genotype Gm3, which is much higher than 0.0020 recorded in alfalfa, reported by (Markovic et al., 2007b) and (Khan et al. (2007).

Potassium in different growing forages commonly is quite high (McDowell and Valle, 2000). Thus, the grazing livestock consuming primarily a forage diet would receive adequate K. This value meet the requirement of lactating cows 0.90 to 1.00 determined by NRC 1989, and lactating goats which is above 0.80 determined by NRC1981. Also meet the beef cows requirement 0.50 to 0.70 which determined by NRC 2000. In case of deficiency, K must be supplied daily in the diet, because, K is not readily stored.

The mean P concentration across all sites of 2.9 g P kg) These ranges and the mean concentration are comparable with those reported in Ketterings et al. (2004) and higher than the 2.3 g kg)1 average P concentration reported for maize across 71 sites throughout NY in 2001–2003. (Ketterings et al. 2005b) and 2.4 g kg)1 reported as a 5-year average for maize by the Dairy One (2006). TheBMRS · S P concentrations are similar to those reported for small grains, clovers and other

The effect of genotypes on P content was insignificant. The highest value was 0.2610 % recorded for the genotype Gm1. Ketterings et al (2006) reported that the mean P concentration across all sites of 2.9 g P kg). Much higher value (0.0028) was recorded in alfalfa (Markovic et al., 2007. This value does not meet the requirement of lactating cows 0.37 to 0.41 determined by NRC 1989, but meet the beef cows requirement 0.17 to 0.39 which determined by NRC 2000.

The data revealed that There was a positive correlation between the CP and digestibility (+0.239) which it is small (0.1- 0.2), As the CP content increased the digestibility was increased, these findings is similar to (Njidda et al 2010) who found a positive correlation between CP and in vitro dry matter digestibility of the same browses, also similar to (Donnelly et al 1969) who noted there was not significant correlation among the crude protein and dry matter digestibility in Sericea lespedeza .

On the other hand the correlation between CP and tannin was negative. Tannins form complexes with proeien this leads to reduce digestability of nitrogen, the consequences are reduced availability of crude protein to animals and increase fecal nitrogen. Vitti et al. (2005) concluded in an experiment with various tanniniferous legumes that neither high nor low tannin concentration could be attributed to positive or negative nutritional characteristics.

Also the correlation between CP and saponin was negative – 0.438. A significant correlation was noted between digestibility and tannin content – 0.473, As the tannin content increased the digestibility was decreased and vice versa. This is result was in conformity with (Duncan, 1984; Barry and Manley, 1984) who found high level of condensed tannins in temperate legumes have been associated with reduction on dry matter digestibility.

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