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THE NUTRITIONAL VALUE OF SEVEN GUAR (*Cyamopsis tetragonoloba*) FORAGE GENOTYPES

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Abstract: This study was aimed to evaluate genotypes of Guar (*Cyamposis tetragonoloba*) as feed for ruminant. Seven guar genotypes were used in this study namely: L10, $L5_3$, Gm1, Gm10, Gm3, Gm6 and Gm7. The evaluation was done by determining CP, CF, EE, Ash, NFE, NDF, ADF, ADL, calculated metabolizable energy ME, relative feed values (RFVs) and dry matter degradability. The proximate analysis components of seven guar forage genotypes showed that there were highly significant differences ($P \leq 0.01$) between parameters (CP, CF, EE, Ash, NFE, NDF, ADF and ADL). The highest value (28.74%) for CP was recorded for genotype Gm1, while the lowest value (23.82%) was attained for genotype Gm3, while highest value (34.8 %) of NFE was recorded for genotype Gm3. The value for neutral detergent fiber (NDF) ranged from 38.16% to 45.51% with the highest value recorded for genotype ($L5_3$). On the other hand, the value for the acid detergent fiber (ADF) ranged between 28.93% to 34.52%, with the highest value recorded for genotype (L10). Moreover, the highest value for metabolizable energy (9.35) was secured by Gm7 while the lowest value (8.51) was obtained for genotype $L5_3$. The results of dry matter degradability revealed that highly significant difference ($P \leq 0.01$) was found between parameters. For readily degradable fraction (a) and slowly degradable fraction (b), a highly significant differences were found between the genotypes, in both parameters the genotypes $L5_3$ (34.6) and Gm1 (53.2) secured the highest value respectively. The highest potential degradability (PD) (74) was recorded for genotype Gm7, while the lowest for genotype $L5_3$ (66.5). For the effective degradability (ED) genotype Gm7 secured the highest value at %2, 5% and 8% out flow rate. Moreover, highly significant differences ($P \leq 0.01$) were obtained between RFVs, the highest value (159.1) for RFVs was found for genotype (Gm7). At 6 hrs of incubation 50 % of degradability occurred. It could be concluded that all Guar forage genotypes can be considered as a good animals feed regarding the high CP content and high degradability values, but GM7 was superior.
Keywords: *Cyamopsis tetragonoloba*, chemical composition, digestibility, genotypes.

Introduction

The livestock in Sudan is estimated to be 135 million heads (Ministry of Animal Resources, 2011), although this huge number, and due to a number of constraints, the productivity of the sector is very low. Among these constraints, inadequacy of feed in terms of quality and

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quantity is considered to be very critical. It is thus essential to address these nutritional constraints if remarkable improvements in livestock productivity are to be achieved.

Fodder crops play a vital role in agriculture because supply of nutritious fodder in sufficient amount is a basic requirement for livestock to fulfill the increasing demand of milk, butter and other dairy byproducts for utilization by human beings (Ayub, et al 2013).

Guar [Cyamopsis tetragonoloba L.) called as cluster bean is a leguminous self pollinated crop (Fabaceae family). It is one of the most important and potential vegetable gum industrial crop grown for its tender pods and endospermic gum (Patil, *et al* 2014). It can be grown as grain, green manure or vegetable crop and fodder purposes. Despite the importance of this crop, only limited breeding work has been done and very little attention has been given for its genetic improvement in the past, in order to enhance the productivity levels and forage quality. Therefore, there is a great opportunity for forage breeders in identifying the genetic make-ups that are superior green fodder yield and quality (Kapoor, 2014). Hence the aim of this study was to estimate the nutritional value of some genotypes of guar (Cyamopsis tetragonoloba) on livestock feed.

Methodology

Sample collection

The samples were provided from a field trial at the department of agronomy faculty of agriculture, university of Khartoum. The whole plant forage samples of Guar were ground and were subjected to statistical analysis. Seven genotypes of guar (*Cyamopsis tetragonoloba*) were used in this study.

Chemical analysis:

Seven genotypes were used to determine the proximate components. DM, Ash and CP according to AOAC methods (AOAC, 1990). NDF, ADF and ADL were determined according to Georing and Van Soest (1970). The relative feed value (RFV) was calculated according to Stallings (2005) following the equation:

RFV = [(88.9 - 0.78 x ADF %)) x (120/NDF %)]/1.29

The Metabolizable energy **ME** (M J/ Kg DM) content was calculated using equations suggested by (Ellis, 1981) As follows:

ME (MJ/Kg DM) =0.012CP+0.031EE+0.005CF+0.014NFE.

In situ dry mater degradability:

In situ degradability of the samples was determined according to procedure described by (Øroshov and McDonal, 1979). Each forge sample of guar weighing **5 g** was transferred into nylon bags with a dimension of 8 x 14 cm and a porosity of 40-45mm and incubated in duplicate in two rumen fistulated steers. The samples containing nylon bags were incubated for 4, 8, 16, 24, 48 and 72 hours, and there after hand washed using tap water. Zero hour solubility was also determined by hand washing samples containing in nylon bags in a similar way to the incubated feed samples. The washed samples were air dried in oven at 105 c to constant weight to determine dry matter degradability. The in situ degradability parameters were fitted using the equation $P = a+ b\ (1- e^{-ct})$, where P is the DM disappearance at time t, an immediately soluble (wash loss), b the slowly degradable fraction and c the rate of degradation (Øroshov and McDonal, 1979).

Statistical analysis:

The data was subjected to analysis of variance (ANOVA) for the completely randomized block design (Steel and Torrie, 1980). The least significant difference (LSD) procedure was used for mean separation. .

Results and Discussion

The presented result in table (1) Revealed highly significant difference among genotypes ($P \leq 0.01$). The highest value of CP content was found to be in genotype Gm1 (28.75%) compared with the lowest value in genotype Gm3 (23.82%), this result is in agreement with (Saleem *et al.,* 2002), who presented that for three varieties of Guar cultivars; there was a significant differences among different varieties for CP content. They also presented that BR-99 contains 34.84% CP against 33.5% and 28.9% CP which was found for BR-90 and 2\1 respectively. Similar results of crude protein content for Guar were noted by (Mahala *et al*., 2012) who reported 23% CP content at 60 days harvesting time. In addition to that this results were comparable to the results reported by (Amrita, 2012) who reported 25.2% CP content for Guar. For another forage crops, Kalamani and Michael (2001) reported 21.5% CP for *Clitoria ternatea*.

These results were disagreed with the results obtained by (Nasrullah *et al*., 2013), who reported that the chemical composition of Guar fodder is 17% DM, 17% CP, (Gomaa *et al*., 2007) recorded 17.06% CP for Guar forage yield at 60 days old. On the other hand, Crude fiber content of Guar genotype is summarized in table 1. The data revealed that all the genotypes have a significant difference between them. The highest value of CF content (24.95 %) was found to be in genotype ($L5_{3}$), while the lowest value (17.82) was found in genotype (Gm7).This results were comparable with Ayub, et al (2013) who reported that the Maximum crude fiber for cluster bean was (31.56 %) and (Mahala *et al*., 2012).

EE of Guar genotypes in this study is ranged from 2.1% in genotype (Gm10) to 1.22% in genotype (Gm1). This in agreement with 1.9% E.E as average on DM% for fresh forage and 2.2% as dry forage which reported by (FAO, 2012), also this results could be comparable with 1% and 2.5% EE for Guar forage at 45 and 60 days from sowing respectively at first and second harvesting times as showed by (Mahala *et al*., 2012).

The data for ash content showed that the highest value (13.4%) for Ash was recorded for genotype (Gm6), while the lowest value (11.7 %) was recorded for genotype (Gm10), these values were higher than 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).

Regarding the contents of NDF and ADF for Guar forage table (2), significant differences between genotypes were observed. For NDF and ADF, genotype (L53) secured the lowest value which were (38.16) and (28.93%) respectively. These results were relatively lower than that reported by (Nasrullah et al., 2013) who reported 52.5% for NDF and 42.5% for ADF. In addition, the values of (42-48%) for NDF and (37-42%) for ADF were reported by (Kumar et al, 2012). Moreover, these results were nearly comparable with the findings obtained by (Das, et al., 1975) (Mahala et al., 2012). The maximum cell wall concentration (NDF) of diets that will not hinder intake and animal production can be as high as 700-750 g/kgDM for mature beef cows and as low as 150-200 g/kg DM for finishing ruminants (Buxton, 1996). Therefore, the high NDF content in these fractions and varieties might have a negative effect on intake and performance of animals. The relative feed values are a measure of forage quality, it is determined between digestibility and potential intake and CP is not included in the equation because it is not highly correlated with digestibility or intake.

The mean RFV index of seven guar genotypes is illustrated in table 2. RFVs varies between 159 for genotype GM7 and 128.2 for genotype GM10. The RFV index as a rule is used to rank feeds relative to full bloom alfalfa hay known to have RFV index of 100 and considered to be a standard value against which other feeds are compared Accordingly, feeds with RFV index higher than 100 are considered to be of higher quality compared to full bloom alfalfa hay and those with a value lower than 100 are of lower value. (Diriba et al 2013). The results were comparable to that reported by (Mahala et al., 2012), who stated that the RFVs of Guar forage were 123, 98 and 118 at 45, 60 and 75 days harvesting time respectively and 94 in

Clitoria ternatea but 141 agree in Lablab purpureus at cutting the firsy t than that reported b. This results were lower than the result reported by (Diriba et al 2013) for “noug” cake that had a RFV of 197. Accordingly, it may be noted that this high of RFV could be attributed to low NDF, ADF.

As shown in Table 3, the highest ME observed in this study for genotype Gm7 (9.35) and lowest value found in genotype L53 (8.51) with highly significant difference ($P<0.01$) between them. Slight lower results were reported by (Evitayani, et al 2004) who reported that ME content of legumes ranged from 6.5 MJ/kg (C. pubescens) to 8.3 MJ/kg (L. leucocephala). In earlier report, Devendra (1982) obtained that the ME content of tropical legumes varied from 6.14-8.66 MJ/kg. (Mahala et al., 2012) mentioned that ME is 5, 6.1 and 4.7 at 45, 60 and 75 days harvesting time respectivelyuar, and 5.2 in Lablab purpureus and 5.8 in Clitoria ternatea at 45 days harvesting time. Similr Results were obtained by (FAO, 2012). Reported 9.1 MJ/Kg DM for Guar forage fresh and 9.2 MJ/Kg DM for Guar forage dry.

Table 1. Chemical Composition Content (%) of Seven Genotypes of Guar (*Cyamopsis tetragonoloba*) Forage

Genotype	DM%	CP%	CF%	E.E%	ASH%	NFE%
SHG L10	88.69^{d}	26.290^{c}	19.395^{c}	1.540^{b}	12.780^{ab}	28.685^{cd}
SHG L5$_3$	90.92^{c}	24.925^{d}	24.945^{a}	1.295^{c}	12.080^{bc}	27.675^{d}
SHG Gm1	91.65^{bc}	28.735^{a}	19.115^{d}	1.215^{d}	13.035^{a}	29.545^{bc}
SHGGm10	91.92^{ab}	27.710^{b}	20.130^{b}	2.075^{a}	11.695^{c}	30.310^{b}
SHG Gm3	91.33^{bc}	23.815^{e}	18.215^{f}	1.485^{b}	12.990^{a}	34.825^{a}
SHG Gm6	91.39^{bc}	27.725^{b}	18.960^{e}	1.465^{b}	13.445^{a}	29.790^{b}
SHG Gm7	92.45^{a}	24.760^{d}	17.815^{g}	2.065^{a}	13.155^{a}	34.650^{a}
SEM	0.2229	0.1544	0.00945	0.0238	0.2212	0.3289

Letters within columns with different superscript differ significantly ($P< 0.05$)
SEM=Stander Error of Means. L.S=Level of Significance.

Table 2: Fiber fractions, relative feed value and Metabolizable Energy (MJ/kg DM) of Guar (*Cyamopsis tetragonoloba*) Forage

Genotype	NDF%	ADF%	ADL%	RFV	ME(MJ\KgDM)
SHG L10	42.435^{c}	34.520^{a}	5.375^{a}	135.93^{e}	8.62^{d}
SHG L5$_3$	45.510^{a}	28.930^{f}	2.510^{g}	135.65^{e}	8.51^{d}
SHG Gm1	42.515^{c}	32.320^{c}	5.035^{b}	139.43^{d}	8.92^{c}
SHGGm10	45.380^{b}	33.885^{b}	3.975^{d}	128.13^{f}	9.22^{b}
SHG Gm3	40.680^{e}	34.340^{ab}	4.095^{c}	142.12^{c}	9.10^{b}
SHG Gm6	41.415^{d}	31.340^{d}	3.915^{e}	144.84^{b}	8.90^{c}
SHG Gm7	38.160^{f}	30.360^{e}	3.245^{f}	159.06^{a}	9.35^{a}
SEM	0.0290	0.1598	0.0104	0.3429	0.0383
L.S	**	**	**	**	**

Means with different superscripted in some column were significantly at ($P< 0.05$).

NDF =neutral detergent fiber; ADF=acid detergent fiber; ADL=acid detergent lignin; RFV= Relative Feed Value; ME= Metabolizable Energy (MJ/kg DM). SEM: Standard error of means. L.S=Level of Significance.

Mean proportions of dry matter degradability for seven genotypes of Guar forage at different periods of incubation in the rumen is illustrated in table 3. The data revealed that there was significant differences between all parameters under study ($P\leq0.01$). Large differences in ruminal degradation between varieties may be related to their genetic characteristics reflected in large variability in morphological and chemical compositions (Agbagla-Dohnani *et al.*, 2001).The readily degradable fraction (a) for seven Guar forage ranged between (16- 34.6 %). Genotype GM_7 recorded the highest value of readily degradable fraction (a). For this genotype as illustrated in table 1 and 2, had the highest value of NFE and lowest value NDF, which my reflected in this result. Maheri-Sis, *et al.*, (2011) reported that Soybean straw have a very low degradable fraction (a) found to be (0.47%), and suggested that the high stems proportion might lead to decrease Soybean straw degradability in digestive system of ruminants. The degradable fraction (a) for Lablab (40.7) which was reported by (Mupangwa *et al.*, 1997), was higher than what was found in this result. Similar result was reported by (Baloyi *et al.,* 2008) for readily degradable for *Vigna unguiculata* (Cowpea) (29.7). The slowly degradable fraction (b) is a measure of the presence of some feed for a long time in the rumen and its degradation slowly, such as some feed containing a high proportion of protein and fiber is difficult to digest. It could be expected that, forage of high slowly degradable fraction may contain the highest rate of fiber content. This assumption could be proved in this study. Genotype (Gm1) which has the highest value of slowly degradable fraction (b), contains the highest values of NDF, ADF and ADL. Thiago *et al., (*1979) concluded that intake of forage is influenced by rate of clearance of dry matter from the rumen by absorption or onward passage of undigested material. It seems reasonable to surmise that rate of passage by absorption depends on rate of fermentation in the rumen. The slowly degradable fraction (b) for Soybean straw SBS (36.5) who registered by (Maheri-Sis, *et al.*, 2011) and (38.4) for Cowpea demonstrated by (Baloyi *et al.,* 2008) and (44.0) for Lablab which reported by (Mupangwa *et al.*, 1997) were in harmon with results.

For the rate degradability (c), the data revealed that there was highly significant differences ($P\leq0.01$) observed between different genotypes ranging from (0.01075 to 0.2020) in table 3. These results were slightly similar to (0.05) for Lablab reported by (Mupangwa *et al.*, 1997) and (0.09) for Cowpea reported by (Baloyi *et al.,* 2008) but disagree with (0.027) Soybean straw reported by (Maheri-Sis, *et al.*, 2011). (Verbicˇ *et al.*, 1995) showed that the variability in effective degradability is mostly associated with the concentration of ADF. The higher fiber compared to the other legumes probably resulted in lower DM degradability since high NDF and ADL results in lower fiber degradation (Van Soest, 1988).

For potential dry matter degradability (PD), the data revealed that there was highly significant differences ($P \leq 0.01$) observed between different genotypes ranging from (66.5 to 74.0). The potential degradability (PD) is a measure of the proportion of feed can be fermented in the rumen if the feed does not pass to the lower digestive tract before maximal degradation occurs by (Mupangwa *et al.*, 1997). tropical legumes have leave with low cell wall content and high proportion of readily digestible thin-walled non-lignified mesophyll tissue which results in greater degradation (Norton and Poppi, 1995).The high potential degradability which was observed in this study may indicated that the feed might need to stay in the rumen for longer time (Baloyi *et al.,* 2008). Same as reported by (**Ximena, and René,** 2011) who indicated that for alfalfa, the high potential degradability could be associated with the presence of large quantities of soluble fraction *a*) and high degradability of slowly degradable fraction *b*, resulting in low amounts of undegradable fraction *U*. The potential DM degradation for Lablab (84.2%) which reported by (Mupangwa *et al*., 1997), was higher than the highest value of PD reported in this result (74.0). Which a similar result was reported by (Baloyi *et al.,* 2008) for DM degradability for *Vigna unguiculata* (Cowpea) (68.1). In contrast (Maheri-Sis, *et al.*, 2011) worked on Soybean straw SBS reported that the PD was found to be (36.97%). The high degradability in the rumen could be due to a combined action of both proteolytic and cellulolytic enzymes in the rumen (Molina-Alcaide *et al.,* 1996).

The Effective Degradability (ED) at out flow rate ($0.02h^{-1}$), ($0.05h^{-1}$) and ($0.08h^{-1}$) was reported in the table 3. It could be observed that the Effective Degradability decreasing with an increase in rumen outflow rates. (Mupangwa *et al*., 1997) observed decline in ED for DM with the outflow rates.

Fig 1 shows the dry matter degradability with time. At 6 hours of incubation, the large proportion of degradability was occurred, which was (49.8 %) for GM10 and (57.7%) for GM7, while for 24 hours of incubation for all forage genotypes, the dry matter degradability ranged between (71.6%-65.8%), indicating that, substantial amount of dry matter were degraded in the rumen, thus providing rumen degradable nitrogen and organic matter for rumen microbial synthesis.

Table 3. Dry matter Degradation Kinetic of Genotypes of *Cyamopsis tetragonoloba* Forage

Genotype	a	b	a	PD	ED0.02% $K=0.02h^{-1}$	ED0.05% $K=0.05h^{-1}$	ED0.08% $K=0.08h^{-1}$
SHG L10	20.45^{e}	52.50^{b}	0.1615^{b}	73.10^{b}	66.95^{b}	60.35^{b}	55.40^{b}
SHG L5$_3$	34.60^{a}	31.90^{e}	0.1605^{b}	66.50^{e}	63.05^{d}	59.00^{c}	56.00^{b}
SHG Gm1	16.00^{f}	53.20^{a}	0.2020^{a}	69.20^{d}	64.85^{c}	59.05^{c}	54.50^{d}
SHG Gm10	22.15^{c}	48.10^{c}	0.1075^{f}	70.25^{c}	62.75^{d}	55.00^{e}	49.80^{f}
SHG Gm3	20.95^{d}	52.10^{b}	0.1500^{c}	72.95^{b}	67.25^{b}	60.40^{b}	55.35^{c}
SHG Gm6	27.70^{b}	39.35^{d}	0.1410^{d}	67.05^{e}	62.15^{e}	56.75^{d}	52.80^{e}
SHG Gm7	34.30^{a}	39.75^{d}	0.1155^{e}	74.00^{a}	68.05^{a}	62.00^{a}	57.80^{a}
SEM	0.1052	0.2018	0.0022	0.2027	0.1500	0.1239	0.1150
L.S	**	**	**	**	**	**	**

Values in the same column with different superscripts differ significantly ($P<0.05$) **= ($P\leq 0.01$). a: Water soluble fraction, b: Water insoluble fraction, c: Rate of degradation. PD: Potential degradability, ED: Effective degradability at three levels of rumen out flow rate. SEM: Standard error of means. L.S=Level of Significance.

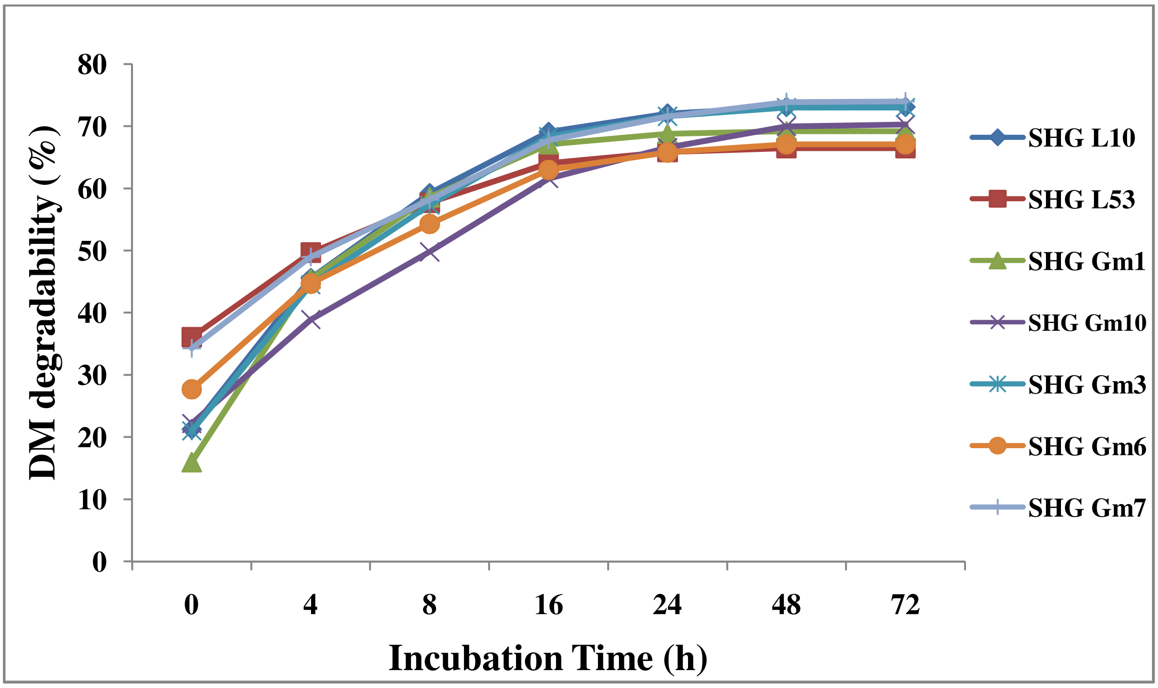

Fig.1. Dry matter Degradability kinetics of Guar (*Cyamopsis tetragonoloba*) Forage (different genotypes) over time

Conclusions

The proximate analysis, RFV, ME (MJ/Kg DM) and DM degradability content of seven Guar genotypes were found to be highly significantly different ($P\leq 0.01$) between the genotypes. From the results, genotype (Gm7) recorded the highest value of RFV, ME, NFE, readily degradable fraction (a), PD degradability (at 48 h) and effective degradability at all outflow rate, in addition, it recorded the lowest value of slowly degradable fraction (b), CF, NDF, ADF indicated that the (Gm7) is the best genotype despite, it was not superior in term of CP and it can provide the animals with very good quality forage

References

[1] Agbagla-Dohnani, A., Nozi`ere, P., Cl`ement, G., Doreau, M. (2001). In Sacco degradability, chemical and morphological composition of 15 varieties of European rice straw. Anim. Feed Sci. Technol. 94, 15-27.

[2] AOAC (1990). Official methods of analysis. 15th edn. Association of official analytical chemists, Washington DC.

[3] Ayub, M., Ali, S.A. Tahir, M. Tahir, Sh. Tanveer, A.and Siddiqui, M.H. (2013) Evaluation the role of phosphorous bacterial solubilizing inoculation and phosphorous application on forage yield and quality of cluster bean (Cyamopsis tetragonoloba L.). International Journal of Modern Agriculture, Volume 2, No.1, 2013

[4] Baloyi, J.J., Ngongoni, N.T., HamodiKuwanda, H. (2008). Chemical composition and ruminal degradability of cowpea and silver leaf desmodium forage legumes harvested at different stages of maturity. Tropical and subtropical agroacosystems, 8 (1).

[5] Buxton, D.R. (1996). Quality-related characteristics of forages as influenced by plant environment and agronomic factors. Anim. Feed Sci. Technol. 59, 37-49.

[6] Das, B., ARoRa, S.K and Luthra, Y.P. (1975). Variability in Structural Carbohydrates and in vitro Digestibility of Forages.3. Guar (Cyamopsis tetragonoloba). Journal of Diary Science, 58 (9).

[7] Devendra, C. 1982. The nutritive value of Leucaena leucochepala cv Peru in balance and growth studies with goats. Malaysian Agricultural research and Development Bulletin 10:183-150.

[8] Diriba Geleti, Mekonnen Hailemariam, Ashenafi Mengistu and Adugna Tolera (2013) Nutritive Value of Selected Browse and Herbaceous Forage Legumes Adapted to Medium Altitude Subhumid Areas of Western Oromia, Ethiopia. Global Veterinaria 11 (6): 809-816

[9] Ecocrop database, Guar (Cyamopsis tetragonoloba) forage, seed and meal (2010). Feedipedia - Animal Feed Resources Information System - INRA CIRAD AFZ and FAO © 2012.

[10] Ellis N (1981). Nutrient composition of Sudan animal feeds. Bulletin 1 central Animal Nutrition research laboratory, Kuku. Khartoum North.

[11] Evitayani, L. Warly, A. Fariani, T. Ichinohe and T. Fujihara (2004). Study on Nutritive Value of Tropical Forages in North Sumatra, Indonesia. Asian-Aust. J. Anim. Sci. Vol 17, No. 11: 1518-1523)

[12] FAO, (2012). *Guar* (*Cyamopsis tetragonoloba*) *forage, seed and meal*. Feedipedia.org. A programmed by INRA, CIRAD, AFZ and FAO. http://www.feedipedia.org/node/311.

[13] Gomaa, A.M. and Mohamed, M.H. (2007). Application of Bio-Organic Agriculture and its Effect on Guar (Cyamopsis tetragonoloba L.) Root Nodules, Forage, Seed Yield and Yield Quality. World Journal of Agricultural Sciences 3(1): 91-96.

[14] Kalamani A.S., Michael Gomez S., (2001). Genetic variability in clitoria spp. Ann. Agr. Re. 22:243-245.

[15] Kapoor, R. (2014) Genetic variability and association studies in guar [Cyamopsis tetragonoloba (L.) Taub.) for green fodder yield and quality traits. Electronic Journal of Plant Breeding, 5(2): 294-299.

[16] Krishnamoorthy, U., H. Soller, H. Steingass and K.H. Menke. 1995. Energy and protein evaluation of tropical feedstuffs for whole tract and ruminal digestion by chemical analyses and rumen inoculum studies in vitro. Anim. Feed Sci. Technol. 52:177-188.

[17] Kumar, S., Agrawal, R.K., Dixit, A.K., Rai, Arvind K. and Rai, S.K. (2012). Forage Crops and Their Management. Indian Grassland and Fodder Research Institute, Jhansi-284003, Uttar Pradesh, India. pp 60.

[18] Mahala, A.G., Amasiab, S.O., Monera, A.Y.and Elsadig, A. (2012). Effect of Plant age on DM yield and nutritive value of some leguminous plants (Cyamopsis tetragonoloba, Lablab purpureus and Clitoria (Clitoria ternatea). Int. Res. J. Agric. Sci. Soil Sci. 2(12): 502-508.

[19] Maheri-Sis, N., Abdollahi-Ziveh, B., Salamatdoustnobar, R., Ahmadzadeh, A., Aghajanzadeh-Golshani, A. and Mohebbizadeh, M., (2011). Pakistan Journal of Nutrition 10 (9): 838-841.

[20] Marf :Ministry of Animal Resources (2004). Estimate of livestock population by state.

[21] Molina-Alcaide, E., Weisbjerg, M.R. and Hvelplund, T. (1996). Degradation characteristics of shrubs and the effect of supplementation with urea or protein on

microbial production using continuous culture system. Journal of Animal Physiology and Animal Nutrition 75: 121-132.

[22] Mupangwa, J.F., Ngongoni, N.T., Topps, J.H. and Ndlovu P. (1997). Chemical composition and dry matter degradability profiles of forage legumes Cassia rotundifolia, Lablab purpureus and Macroptilium atropurpureum at 8 weeks of growth. Anim. Feed Sci. Tech., 69: 167-178.

[23] Nasrullah, Abdullah, M., Baber, M.E., Abdul Jabber, M. and Bahtti, J.A. (2013). Feeding Behavior, Voluntary Intake and Digestibility of Various Summer Fodders in Sheep and Goats. Pakistan J. Zool., 45 (1): 53-58.

[24] Norton, B.W., Poppi, D.P. (1995). Composition and nutritional attributes of pasture legumes. In: D'Mello, J.P.F., Devendra, C. (Eds.), Tropical Legumes in Animal Nutrition. CAB International, Wallingford, UK pp. 23-48.

[25] NRC (1980). Mineral Tolerance of Domestic Animals. National Academy Press, Washington, DC. (SF757.5.N27).

[26] NRC (National Research Council), (1996). Nutrient requirement for beef cattle (7thEd). National Academy press Washington, D.C. 142. National Research Council.

[27] Øroshov, E.R. and McDonal, P. (1979). The estimation of protein degradability in the rumen from incubation measurements weighed according to rate of passage, J. Agric. Sci. 92: 499-503.

[28] Patil, D.V. (2014). Genetic component of variance of Guar and its response to sowing dates in semi arid region of Maharashirta, India. Plant Archives Vol. 14 No. 1, 2014 pp. 125-131

[29] Saleem, M.I., Hussain Shah, S.A., Akhtar, L.H. (2002). BR-99 Anew Guar Cultivar Released for General Cultivation in Punjab Province. Asian Journal of Plant Sciences. 1 (3): 266-268.

[30] Stallings CC (2005). Test available for measuring forage quality. Dairy publication, 404 – 124 Pp: 1 -3 www .ext .vt .edu

[31] Steel RGD, Torrie JH (1980). Principles and procedures of statistics, 2nd ed. McGraw –Hill publishing Company. NY.

[32] Thiago, L.R.L., Kellaway, R.C., and Leibholz, J. (1979). Kinetics of forage digestion in the rumen. Annals of Veterinary Research 10, 329-31.

[33] Tolera, A., Sundstøl, F. (2001). Prediction of feed intake, digestibility and growth rate of sheep fed basal diets of maize stover supplemented with Desmodium intortum hay from dry matter degradability of the diets. Livest. Prod. Sci. 68, 13-23.

[34] Van Soest, P.J. (1988). Effect of environment and quality of fiber on the nutritive value of crop residues. In: Reed, J.D., Capper, B.S., Neate, P.J.H. (Eds.), Plant Breeding and the Nutritive Value of Crop Residues. Proceedings of a Workshop held at ILCA, Addis Ababa, Ethiopia, 7-10 December 1987, pp. 71-96.

[35] Verbicˇ, J., Stekar, J.M.A., Resnik-Cˇepon, M. (1995). Rumen degradation characteristics and fiber composition of various morphological parts of different maize hybrids and possible consequences for breeding. Anim. Feed Sci. Technol. 54, 133-148.

[36] Ximena Valderrama L. and René Anrique G. (2011). Intion kinetics of high protein forage crops in temprate climate. Chilean journal of agricultural research, 71(4)