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Nutritional Evaluation of Forages in Kashin-Dila Rangeland of Mallam-Madori LGA, Jigawa State, Nigeria

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Abstract
This study was conducted to determine the proximate composition, fibre fractions, energy and mineral contents, as well as the anti-nutritional contents of the most common forage species available in 564.2 hectares of Kashin-dila rangeland. Samples were collected monthly from July to November in 2023 using a 1m x 1m open-ended quadrat. Samples collected were identified, after which the eight most common ones were taken to the laboratory for nutritive evaluation in triplicate per month. Data generated were analyzed using GENSTAT, and significant differences were separated using Tukey. The result showed that *Pennisetum pedicellatum, Cynodon dactylon, Sphaeranthus angustifolius, Cyperus esculentus, Kyllinga brevifolia, Senna obtusifolia, Leptadenia hastata* and *Guiera senegalensis* were the most common forage species in the rangeland. The nutritional compositions were significant ($p < 0.05$), forages could be considered good, in terms of overall CP, ASH and NFE, except for EE, CF and energy. It can be concluded that forage quality varies greatly among these common forages, however majority could meet the requirement of ruminant animals' production.
Keywords: Evaluation, Forages, Kashin-dila, Nutritive values, and Rangeland

Introduction

Nigeria is one of the topmost livestock producers in Central and West Africa, with huge economic potential worth over 33 trillion naira. At the national level, livestock production contributes about 5% of GDP, whereas agriculture contributes 23% of GDP (NAERLS/FMARD, 2022). One of the major constraints to livestock production in developing countries including Nigeria, is the scarcity and fluctuating quantity and quality of the year-round feed supply (Olafadehan and Okunade, 2016). Even though livestock plays a crucial role in agriculture, productivity per animal is very low, and the contribution of the sector to the overall economy is much lower than expected due to many factors including poor nutrition (Mekuanint *et al*., 2015). Consequently, the productivity of ruminant livestock in the tropics and subtropics is limited by the inadequacy of good quality and nutritive feed. This becomes critical during the long dry season when the little available standing hay forages are lignified with adverse effects on voluntary intake, digestibility, productivity and reproductive performance (Olafadehan and Okunade, 2016). The nutritional values of forage species are low in the dry seasons compared to the wet season (Cinar *et al*., 2020; Buxton, 1996). This is a result of the dependence of forage nutrient contents on the amount of moisture found in the soil in which the plants grow (Godari *et al*., 2013; McDowell *et al*., 1983). In addition, concentrations of nutrients in forage plants are dependent upon the interaction of several factors. These factors are climate, plant species, soil properties, plant age and management (Andueza *et al*., 2010). According to the Agricultural Production Survey, there are over 158 million ruminant livestock in Nigeria (NAERLS/FMARD, 2022). These ruminant animals rely more essentially on rangeland and pasture for their nutrient requirement than on any other feed resources (Godari *et al*., 2013).

Knowledge about the quality of forage in rangelands is important to determine the grazing capacity in the rangeland (Godari *et al*., 2013). Forage quality is also significant because it is linked to animal performance. Reaching high levels of animal performance and health is dependent on high-quality nutrition, and the failure to meet minimum nutritional requirements of the animals leads to a decrease in animal production such as milk, weight and reproductive rates, and to susceptibility to diseases (Amary, 2016; Pinkerton, 2005). Furthermore, the quality of forage changes at local scales between different soil types, at larger scales from one region to another and temporal scales from season to season based on the type of vegetation cover (Godari *et al*., 2013). Thus, understanding the spatial and temporal changes in forage quality in the rangeland is essential for livestock farmers. The concept of forage quality stems from the interaction between the physicochemical properties of plants and the animals' physiological ability for ingestion, digestion, nutrient absorption and utilisation (Amary, 2016; Estell *et al*., 2014; Alonso *et al*., 2008; Pinkerton, 2005). Assessing the forage quality of rangelands can provide us with knowledge of the forage nutritive value and livestock grazing capacity of the rangeland (Amiri and Mohamed Shariff, 2012). Proteins, fibre, and mineral elements such as phosphorous, potassium and calcium are all nutritional requirements for the well-being of livestock (McDonald *et al*., 2010; Brisibe *et al*., 2009). Therefore, key aspects to consider when evaluating forages include the protein, fibre and mineral nutrient concentrations (Juárez *et al*., 2013).

Materials and Methods

This research was carried out in Kashin-dila rangeland of Mallam-Madori Local Government Area of Jigawa State, Nigeria. The area is located close to Kashin-dila village, along Hadejia-Mallam-Madori road (9km and 12km away from Mallam-Madori and Hadejia towns respectively). The average altitude of the rangeland is 356m above sea level and the total area covers 564.2 hectares on latitude $12^{0}30^{'}22"$ N and longitude $9^{0}56'53"$ E. The annual rainfall ranges between 200 - 600mm with a relative humidity of 75 % during the rainy season and a mean annual temperature of 28 ^{0}C. Cattle, sheep and goats are usually the most important animals grazing in the area by Fulani pastoralists (Field Survey, 2023; Muhammad *et al*., 2023; BirdLife International, 2021).

Forage sample collection

The Quadrat method was used in sampling the forages (Ruvuga *et al*., 2021). A quadrat is a means of defining a small sample area that can be assessed by placing a quadrat on the ground, standing vertically above the quadrat estimating the proportion of the quadrat area occupied by each forage species and finally recording the proportions on the worksheet, this process can be repeated until sufficient sites have been sampled. Every month, from July to November 2023, forage species composition was randomly sampled using a 1m x 1m open-ended quadrat from each replication plot. Within each quadrat samples of the species were identified and scored percentage (%) relative to their proportion within the quadrat and categorized into grasses, sedges, legumes, forbs and browse plants. The species found were then harvested using a knife at 2 cm above the ground level, the harvested species were sorted out and weighed as in the research of Ruvuga *et al.* (2021). The most common samples were sundried and taken to the laboratory for analysis.

Proximate composition

The determination of dry matter (%DM), crude protein (%CP), crude fibre (%CF), ether extract (%EE), nitrogen-free extract (%NFE) and ash (%ASH) of the samples were carried out according to the AOAC (2013). While Fibre fraction; acid detergent fibre (ADF) and nitrogen detergent fibre (NDF) were determined by Van Soest *et al.* (1991). Energy was calculated using Pauzenga's (1985) formula.

Mineral analysis

Calcium (Ca), Phosphorus (P), and Sodium (Na) were measured using a Perkin Elmer atomic absorption spectrometer (AAnalyst 800) by procedures described by AOAC (1999).

Anti-nutritional factors

The presence of anti-nutritional factors; tannin and oxalates were determined according to AOAC (2013) while phytate was determined according to Stewart (1974).

Data analysis

The data generated were subjected to analysis of variance (ANOVA) using the GLM procedure of GENSTAT (2014), where significant differences between the means were detected and separated using Tukey, Differences between the means were considered at a 5% probability level ($p<0.05$).

Results and Discussion

There were different forage species in the rangeland but the most common ones that were widely observed and identified include kyasuwa, bermuda grass, *hura*, yellow nutsedge, spikesedge, sicklepod, leptadenia and *sabara* (Table 1). They are also known by their scientific names as *Pennisetum pedicellatum, Cynodon dactylon, Sphaeranthus angustifolius, Cyperus esculentus, Kyllinga brevifolia, Senna obtusifolia, Leptadenia hastata* and *Guiera senegalensis* respectively. *Senna obtusifolia* and *Guiera senegalensis* (Figures 1 & 2) were the dominant forages covering over 60% of the grassland and shrub land respectively. According to our interview with herders, in terms of animals' preference (forage palatability), *P. pedicellatum, C. dactylon, S. angustifolius* and *C. esculentus* rank equally (preferred) followed by *K. brevifolia* and *G. senegalensis* (accepted) while *L. hastata* and *G. senegalensis* rank last (rejected). Hence, our surveys and discussion with pastoralists reveal that they would like to have more of the preferred forages in their grazing lands rather than other species for the simple reason of maximizing their production.

Proximate compositions of the common forages in the rangeland

The proximate compositions of common forages in the rangeland are presented in Table 2. The dry matter (DM) contents of the forages were significantly different ($P < 0.05$). The average quantity of dry matter content was 92.10% with minimum and maximum values of 87.96% in *Sphaeranthus angustifolius* and 96.10% in *Pennisetum pedicellatum* respectively. The DM content was in line with the range of 88.30% to 91.74% reported by Khan *et al.* (2020) and also close to the report of Njidda *et al.* (2010) who reported a range of 95.20% to 97.00% on some semi-arid browse forages of Northeastern Nigeria. The dry matter yield falls within the range of 500 and 1200kg/ha reported by Aduku, (2004) in the Sudan savannah zone. Moreover, it is important to note that forage dry matter yield varies with rainfall and soil conditions (Aduku, 2004). The crude protein (CP) contents of the forages were significantly different (P < 0.05), which ranged from a minimum of 3.63% in *Guiera senegalensis* to a maximum of 21.54% in *Senna obtusifolia*. The average CP content was 8.81% which was higher than the values of 5.44% reported by Awad and El-Hadi (2010) during the early dry season of the semi-arid rangeland of Sudan. It was also slightly higher than the 8.20% reported by Suleiman *et al.* (2020). The CP content of the forages was also higher than the 8% CP which is the lower threshold that will warrant giving supplements to livestock (Aduku, 2004). The crude fibre (CF) content of the forages was also significantly different (P < 0.05) ranging from 9.06% in *Senna obtusifolia* to 54.10% in *Guiera senegalensis* with an average CF content of 26.44%. The average CF content was not in line with the report of Mckell (1980) who concluded that CF usually ranges between 30% and 40% in mature plants. Also, the report of Norton (1995) that tropical legumes and grasses have a CF content of above 28%. However, the average CF content of the forages was higher than the 21.42% reported by Suleiman *et al.* (2020). Aina and Onwukwe (2002) reported that the chemical composition and nutritive value of the grasses and legume species grown in Nigeria vary greatly depending on the species and season of growth at which the forages are cut or grazed. Low-fibrous grasses and legumes have been reported to increase digestibility and performance (Suleiman *et al*., 2020; Richard *et al*., 1994). The ether extract (EE) of the forages were significantly different (P< 0.05) values ranging from 1.78% in *Sphaeranthus angustifolius* to 4.16% in *Leptadenia hastata* with an average of 2.48%. The mean EE was slightly lower than the values of 3.6% reported for forages of West Africa (Le Houerou, 1980). This study's results agreed with the range of 0.95 – 5.3% reported by Okoli *et al.* (2001). The ash contents of the forages were also significantly different (P < 0.05), values ranged from 2.71% in *Guiera senegalensis* to 16.99% in *Leptadenia hastata* with an average of 7.53%. The average ash content for all the forages in this study was in line with the report of 7.93% in *Moringa oleifera* leaves reported by Ogbe and John (2011). It was also within the range of 4.65% to 13.50% reported by Agida *et al.* (2017). The Nitrogen Free Extract (NFE) content of the forages was also significantly different (P < 0.05). Values ranged from 27.12% in *Guiera senegalensis* to 63.66% in *Cyperus esculentus* with an average of 46.84%. This is in line with the reported range of 21.09% to 46.91% by Khan (2020). The result is also close to the range of 40.90% to 51.10% (Aregheore, 2000).

Fibre fractions and energy contents of the common forages in the rangeland

The fibre fractions and energy contents of the common forages in the rangeland are presented in Table 3. The Neutral Detergent Fibre (NDF) of the forages were significantly different (P <0.05). The average NDF was 47.74% with minimum and maximum values of 36.56% in *Sphaeranthus angustifolius* and 63.40% in *Cynodon dactylon* respectively. This was close to the range of 37.30% to 51.20% reported by Njidda (2010).

The Acid Detergent Fibre (ADF) of the forages were also significantly different (P < 0.05), which ranged from a minimum of 30.45% in *Cyperus esculentus* to a maximum of 38.39% in *Guiera senegalensis*. The average ADF was 34.37%. The ADF was also in line with the range of 16.20% to 41.20% (Njidda, 2010). The chemical composition and nutritive value of the grass and legume species grown in Nigeria vary greatly depending on the species and season of growth at which the grasses and legumes are cut or grazed (Aina and Onwukwe 2002). The energy contents of the forages were also significantly different (P < 0.05), with values that ranged from 185.22 kcal/kg in *Cynodon dactylon* to 1398.76 kcal/kg in *Leptadenia hastata* with an average energy content of 764.65 kcal/kg. The energy content of the forages could be compared to the report of Magdalene *et al.* (2019) in which an energy content range of 381.20 to 560.35kcal/kg was given for wild-edible plants. The result could also be compared to the reports of Suleiman *et al*., (2020) who reported an energy content of 252.52 kcal/kg, Agida *et al.* (2017) with an energy range of 871.94 to 1392.35 kcal/kg and Ogbe and John (2011) that reported energy content of 1440.11kcal/kg.

Mineral compositions of the common forages in the rangeland

The mineral compositions of the common forages in the rangeland are presented in Table 4. The calcium content of the forages was significantly different (P < 0.05). The average calcium content was 4130.19 mg/kg with minimum and maximum values of 934.55 mg/kg in *Senna obtusifolia* and 8936.43 mg/kg in *Guiera senengalensis* respectively. The result was lower than the range of 7500mg/kg to 19500mg/kg reported by Njidda (2010) but is within the wider range of 1600mg/kg to 15200mg/kg of some selected weedy grasses in the observation of Khan *et al.* (2020). The phosphorus contents of the forages were significantly different (P < 0.05), which ranges from a minimum of 34.27 mg/kg in *Leptadenia hastata* to a maximum of 23411.08mg/kg in *Guiera senengalensis*. The average phosphorus content was 7362.81 mg/kg. The average phosphorus content was in agreement with ranges of 1000mg/kg to 9400mg/kg and 1500mg/kg to 10000mg/kg respectively (Khan *et al*., 2020). It can also be compared with the results of Suleiman *et al.* (2020) who reported an average of 31.57 mg/kg and 30.15ppm by Ogbe and John (2011). The sodium contents of the forages were also significantly different (P < 0.05), that ranges from 72.54 mg/kg in *Leptadenia hastata* to 18500 mg/kg in *Sphaeranthus angustifolius* with an average sodium content of 3122.35 mg/kg. The sodium contents of the forages were also low when compared with the reports of Khan *et al.* (2020) and Suleiman *et al.* (2020).

Anti-nutritional factors of the common forages in the rangeland

The anti-nutritional factors of the common forages in the rangeland are presented in Table 5. The phytate levels of the forages were significantly different (P < 0.05). The average phytate level was 52.87 mg/100g with minimum and maximum values of 0.18 mg/100g in *Leptadenia hastata* and 233.45 mg/100g in *Senna obtusifolia* respectively. The research can be compared with the phytate levels of 25.9mg/100g reported by Ogbe and John (2011) and 34.74mg/100g reported by Suleiman *et al.* (2020). The oxalate contents of the forages were significantly different (P < 0.05). No oxalate was found in *Guiera senengalensis*. The oxolate ranges from a minimum of 0.47 mg/100g in *Leptadenia hastata* to a maximum of 80.95 mg/100g in *Senna obtusifolia*. The average oxalate content was 14.54 mg/100g which can be compared with an average level of 4.5mg/100g reported by Ogbe and John (2011) and a range of 4.58mg/g to 8.15mg/g (Njidda, 2010). The tannin contents of the forages were also significantly different (P < 0.05) ranging from 0.17 mg/100g in *Leptadenia hastata* to 364.40 mg/100g in *Senna obtusifolia* with an average tannin content of 141.53 mg/100g. The tannin content of the forages could also be compared to the report of Ogbe and John (2011) in which a tannin content level of 211.9mg/100g was given for *Moringa oleifera* leaves. The research was in line with the observation of Agida *et al.* (2017) who reported the ranges of 0.06mg/g to 62mg/100g.

Conclusion

Forage quality varies greatly among these common forages. Chemical compositions and nutritive values of the grass and legume species grown in Nigeria vary greatly depending on the species and season of growth at which the forage species are cut or grazed. Results of this study revealed that the nutritional composition of the forages could be considered good, in terms of overall CP (8.81%), ASH (7.53%) and NFE (46.84%), except for low EE (2.48%), CF (26.44%) and energy (764.65 kcal/kg). It can be concluded that forage quality varies greatly among these common forages, some forages are better in quality compared to others, most of which are very low in quality and cannot meet the needs of livestock in the study area. However, grasses could also be considered good forages in the rangeland due to their low levels of anti-nutritional contents.

References

Aduku, A. O. (2004). Animal Nutrition in the Tropics: Feeds and Feeding, Pasture Management, Monogastric and Ruminant Nutrition. Davcon Computers and Business Bureau, Zaria, pp. 17 -18

Agida, G. O., Forcados, G. E., Usman, Y., Muraina, I., Ottor, M., Samuel, A. L., Usman, A. S., Makoshi, M. S., Atiku, A. A., Gotep, J. G., Ekundayo, G. N., Oladipo, O. O., Mancha, M. D., Ozele, N., Diugwu, J., Makama, S., Akpojosevbe, J., Tondo, B. and Elisha, I. L. (2017). Proximate, Anti-nutritional and Mineral Composition of Some Pasture Plant Growing in Vom, Nigeria. *Journal of Agriculture,* 4(8): 1-8.

Aina, A. B. J. and Onwukwe, S. C. (2002). Estimation of Nutrient Contents of Some Selected Grasses as Affected by Age of Cuttings. Proceedings of the 7th Annual Conference of Animal Science Association of Nigeria (ASAN), September 16-19, 2002, University of Agriculture, Abeokuta, Nigeria. Pp. 212-214.

Alonso-Díaz, M. A., Torres-Acosta, J. F. J., Sandoval-Castro, C. A., Hoste, H., AguilarCaballero, A. J., and Capetillo-Leal, C. M. (2008). Is goats' preference for forage trees affected by their tannin or fibre content when offered in cafeteria experiments? *Animal Feed Science and Technology*, 141(1) 36-48.

Amary, N. M. (2016). Assessing the Quality of Forage for Livestock in a Semi-Arid Pastoral System in South Africa. *MSc. Thesis.* University of the Western Cape South Africa. 106pp.

Amiri, F., and Mohamed Shariff, A. R. (2012). Comparison of nutritive values of grasses and legume species using forage quality index. Songklanakarin *Journal of Science and Technology* 34(5): 577-586.

Andueza, D., Cruz, P., Farruggia, A., Baumont, R., Picard, F. and Michalet Doreau, B. (2010). Nutritive value of two meadows and relationships with some vegetation traits. *Grass and Forage Science*, 65(3): 325-334.

AOAC, (1999). Association of Official Analytical Chemists. Washington DC: William Tryd Press Richmond Virgina.Washington DC, USA, Pp. 214-230.

AOAC, (2013). Official methods of analysis (19th Edition). Association of Official Analytical Chemists, Washington D.C., USA

Aregheore, E. M. (2000). Nutritive Value and Utilization of Three Grass Species by Crossbred Anglo-Nubian Goats in Samoa. *Journal of South Pacific Agriculture,* 6(1): 1389-1393.

Awad, O. A. and El-Hady (2010). Seasonal Variability in Nutritive Value of Ruminant Diets under Open Grazing System in the Semi-arid Rangeland of Sudan (South Darfur State). O. A. *Agricultural and Biological Journal of North America,* 1 (3): 243-249.

BirdLife International (2021). Important Bird Areas factsheet: Hadejia-Nguru wetlands. Downloaded from http://www.birdlife.org on14/03/2021

Brisibe, E. A., Umoren, U. E., Brisibe, F., Magalhäes, P. M., Ferreira, J. F., Luthria, D., and Prior, R. L. (2009). Nutritional characterisation and antioxidant capacity of different tissues of *Artemisia annua* L. *Food Chemistry*, 115(4): 1240-1246.

Buxton, D.R. 1996. Quality-related characteristics of forage as influenced by environment and agronomic factors. *Animal Feed Science and Technology,* 59(3): 37-49.

Cinar, S., Abdullayev, A., Esenov, N. and Karadag, Y. (2020). Determination of botanical composition, hay yield and forage quality of some natural rangelands in Kyrgyzstan's Chuy Region. *Applied Ecology and Environmental Research,* 18(1):401-416.

Estell, R. E., Havstad, K. M., Cibils, A. F., Anderson, D. M., and Schrader, T. S. (2014). The changing role of shrubs in rangeland-based livestock production systems: Can shrubs increase our forage supply? *Rangelands*, 36(2): 25-31.

GENSTAT, (2014). General Statistics Software for Windows 15th Edition. VSN International, Hemel Hempstead, UK. Web page: Genstat.co.uk.

Godari, A., Ghiyasi, S., and Poor, R. A. (2013). Studying Some Chemical Compositions of *Sphaerocoma aucheri* in Sandy Ranges of Persian Gulf, *Journal of Applied Environmental and Biological Sciences*, 3(5): 36-41.

Juárez, A. S., Cerrillo, M. A., La O, O., Herrera, R. S., Scull, I., Guerero, M., and Bernal, H. (2013). Nutritional value and kinetics of the ruminal fermentation of flowers, tree fruits and shrubs in the Cauto Valley, Cuba. *Cuban Journal of Agricultural Science*, 47(1).

Khan, M. N., Ali, S., Yaseen, T., Adnan, M., Ullah, S., Zaman, A., Iqbal, M., Shah, S. N., Ali, A., Razzaq, A., and Ozdemir, F. A., (2020). Assessment of Proximate Nutritional Contents in Selected Weedy Grasses for Potential Use as Fodder in District Charsadda, K.P. *Proceedings of the Pakistan Academy of Science; Life and Environmental Sciences,* 57(2): 83-94.

Le Houerou, H.N. (1980). Chemical Composition and Nutritive Value of Browse in Africa, the Current State of Knowledge, International Livestock Centre for Africa, Addis Ababa.

Magdalene, O., Okpashi, V. E., and Bayim, B. P. (2019). Comparative Evaluation of Proximate Composition of Selected Wild-edible Plants in Central Cross River State. *Journal of Science, Engineering and Technology,* 6(2): 1-8.

McDonald, P., Edwards, R. A., Greenhalgh, J. F. D., Morgan, C. A., Sinclair, L. A., and Wilkinson, R.G. (2010). Animal Nutrition, Seventh edition.

McDowell, L. R., Conrad, G. H., Ellis, G. L., and Loosli, J. K. (1983). Minerals for Grazing Ruminants in Tropical Regions. University of Florida Gainesville, Florida. 13: 121-128.

Mckell, C. M. (1980). Multiple Uses of Fodder Trees and Shrubs, A Worldwide Perspective. In: Le Houerou, H.N. (Editor), Browse in Africa Current State of knowledge. ILCA, Addis Ababa, Ethiopia. Pp. 144-150.

Mekuanint, G., Ashenafi, M., and Diriba, G. (2015). Biomass yield dynamics and nutritional quality of alfalfa (*Medicago sativa)* cultivars at Debre Zeit, Ethiopia. *Journal of Agricultural Research and Development.* 5: 120–127.

Muhammad, A. S., Muhammad, Y., Dahiru, M., Musa, H., Babandi, B., Musa, B. S., Abdul'aziz, A., Sulaiman, A. S., Abdulkadir, U., Sulaiman, U. U., Gumel, A. M., Yunusa, K., and Mamuda, I. (2023). An Assessment of the Effect of Flooding on Livestock Production in Hadejia, Nigeria. *Proceedings of the 57th Annual Conference of Agricultural Society of Nigeria (ASN), October 23rd – 27th, 2022. At: FULafia Nasarawa State, Nigeria.* Page 1156 -1159.

NAERLS/FMARD (2022). 2022 *National Report of* the *Wet Season Agricultural Performance Survey in Nigeria*. National Agricultural Extension and Research Liaison Services, Ahmadu Bello University, Zaria and the Federal Ministry of Agriculture and Rural Development, Abuja: NAERLS Press. 362 pp. ISBN: 2408-7459 www.naerls.gov.ng.

Njidda, A. A. (2010). Chemical composition, fibre fraction and anti-nutritional substances of semi-arid browse forages of north-eastern Nigeria. *Nigerian Journal of Basic and Applied Sciences*, 18(2).

Norton, B. W. (1995). Differences between species in forage quality. In *Nutritional Limits to Animal Production from Pastures: proceedings of an international symposium held at St. Lucia, Queensland, Australia, August 24-28, 1981/edited by JB Hacker*. Farnham Royal, UK: Commonwealth Agricultural Bureaux, 1982.

Ogbe, A. O., and John, P. A. (2011). Proximate Study, Mineral and Anti-nutrient Composition of *Moringa oleifera* Leaves Harvested from Lafia, Nigeria: Potential Benefits in Poultry Nutrition and Health. *Journal of Microbiology, Biotechnology and Food Sciences,* 1(3): 296-308.

Okoli, I. C., Ebere, O. O., Emenalom, M. C., Uchegbu, L., and Esonu, B. O. (2001). Indigenous Livestock Production Paradigms Revisited. 111: An Assessment of the Proximate Values of Most Preferred Indigenous Browses of Southeastern Nigeria. *Anim. Prod. Invest*., 4: 99-107.

Olafadehan, O. A. and Okunade, S. A. (2016). Fodder value of three browse forage species for growing goats. *Journal of the Saudi Society of Agricultural Sciences*, 17: 43–50

Pauzenga, U. (1985). Feeding Parent Stock. *Zootech. International,* pp. 22-25.

Pinkerton, B. (2005). *Forage quality*. Clemson University Cooperative Extension Service. Forage fact sheet 2.

Richard, D. E., Brown, W. F., Reugsegger, G., and Battles, D. B. (1994). Replacement Value of Tree Legume for Concentrates in Forage-Based Diets. In: Replacement Value of *Glyricidia sepium* for Growing Goats. *Anim. Feed Sci. Technol.*, 46: 37-51.

Ruvuga, P. R., Wredle, E., Nyberg, G., Hussein, R. A., Masao, C. A., Selemani, I. S., Sangeda, A. Z., and Kronqvist, C. (2021). Evaluation of rangeland condition in miombo woodlands in eastern Tanzania about season and distance from settlements. *Journal of Environmental Management,* (290): 1–9. https://doi.org/10.1016/j.jenvman.2021.112635

Stewart, E. (1974). *Chemical analysis of ecological materials.* Oxford (UK): *Blackwell Scientific.*

Suleiman, M., Khadija, A. Y., Nasiru, Y., Garba, A. A., Alhassan, M., and Bello, H. J. (2020). Proximate, Minerals and Anti-nutritional Composition of Water Hyacinth (*Eichhornia crassipes)* Grass. *Earthline Journal of Chemical Sciences.* Vol. 3(1): 51-59.

Van Soest, P. J., Robertson, J. B., and Lewis, B. A.

(1991). Methods for Dietary Fiber, Neutral Detergent Fiber, and Nonstarch Polysaccharides about Animal Nutrition. *Journal of Dairy Science,* 74 (10): 3583–3597. DOI: https://doi.org/10.3168/JDS.S0022-0302(91)78551-2.

Table 1: Most common forage species in the rangeland

Forage	Local name	Specie occurrence	Rank
Pennisetum pedicellatum	Kyasuwa	Common	1
Cynodon dactylon	Kiri-kiri	Common	1
Sphaeranthus angustifolius	Hura	Common	1
Cyperus esculentus	Jiji	Common	1
Kyllinga brevifolia	Gemun kwado	Common	2
Senna obtusifolia	Tafasa	Dominant	3
Leptadenia hastata	Yadiya	Common	3
Guiera senegalensis	Sabara	Dominant	2

1 = preferred, 2 = accepted, 3 = rejected

Figure 1: Tafasa (Senna obtusifolia) is the dominant forage species in the grassland area of Kashin-dila rangeland

Figure 2: Sabara (Guiera senegalensis) is the dominant forage species in the shrubland area of Kashin-dila rangeland

Table 2: Proximate composition of the common forages in the rangeland

Forages	DM (%)	CP (%)	CF (%)	EE (%)	ASH (%)	NFE (%)
Pennisetum pedicellatum	96.10[a]	9.08[c]	35.60[b]	2.72[b]	9.70[c]	39.00[f]
Cynodon dactylon	93.20[c]	9.01[c]	27.90[d]	2.11[e]	9.82[bc]	44.36[e]
Cyperus esculentus	90.34[f]	6.02[d]	16.33[g]	2.12[e]	2.21[g]	63.66[a]
Kyllinga brevifolia	92.70[d]	4.11e	28.40[c]	2.63[c]	9.88[b]	47.68[d]
Senna obtusifolia	94.90[b]	21.54[a]	9.06 [h]	2.33[d]	4.00[e]	57.97[b]
Leptadenia hastata	92.00[e]	13.11[b]	18.63[f]	4.16[a]	16.99[a]	39.11[f]
Sphaeranthus angustifolius	87.96 [h]	3.98[e]	21.46[e]	1.78[g]	4.96[d]	55.78[c]
Guiera senegalensis	89.56[g]	3.63[f]	54.10[a]	2.00[f]	2.71[f]	27.12[g]
Means	**92.10**	**8.81**	**26.44**	**2.48**	**7.53**	**46.84**
P-Value	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

[a, b, c, d] ***Means with different superscripts along the same columns differ significantly (P < 0.05). DM = Dry Matter, CP = Crude Protein, CF = Crude Fibre, EE = Ether Extract, ASH = Ash and NFE = Nitrogen Free Extract.***

Table 3: Fibre fractions and energy contents of the common forages in the rangeland

Forages	NDF (%)	ADF (%)	Energy (kcal/kg)
Pennisetum pedicellatum	43.00[c]	32.90[e]	809.59[e]
Cynodon dactylon	63.40[a]	34.10[cd]	185.22[h]
Cyperus esculentus	38.38[d]	30.45[f]	1090.53[b]
Kyllinga brevifolia	43.50[c]	34.70[c]	317.62[g]
Senna obtusifolia	56.88[b]	34.76[c]	334.17[f]
Leptadenia hastata	57.32[b]	35.97[b]	1398.76[a]
Sphaeranthus angustifolius	36.56[e]	33.58[de]	987.78[d]
Guiera senegalensis	42.87[c]	38.39[a]	993.50[c]
Means	**47.74**	**34.37**	**764.65**
P-Value	**<0.001**	**<0.001**	**<0.001**

[a, b, c, d] ***Means with different superscripts along the same columns differ significantly (P < 0.05), NDF = Nitrogen Detergent Fibre and ADF = Acid Detergent Fibre***

Table 4: Mineral compositions of the common forages in the rangeland

Forages	Ca (mg/kg)	P (mg/kg)	Na (mg/kg)
Pennisetum pedicellatum	7065.24[b]	1966.34[e]	119.62[g]
Cynodon dactylon	4528.87[c]	2443.88[d]	415.08[e]
Cyperus esculentus	1521.55[g]	958.28[f]	318.40[f]
Kyllinga brevifolia	3974.55[e]	8250.66[c]	725.39[c]
Senna obtusifolia	934.55[h]	803.50[g]	506.65[d]
Leptadenia hastata	1778.98[f]	34.27[h]	72.54[h]
Sphaeranthus angustifolius	4301.32[d]	21034.50[b]	18500.00[a]
Guiera senegalensis	8936.43[a]	23411.08[a]	4321.11[b]
Means	**4130.19**	**7362.81**	**3122.35**
P-Value	**<0.001**	**<0.001**	**<0.001**

[a, b, c, d] ***Means with different superscripts along the same columns differ significantly (P < 0.05)***

Table 5: Anti-nutritional factors of the common forages in the rangeland

Forages	Phytate (mg/100g)	Oxalate (mg/100g)	Tannins (mg/100g)
Pennisetum pedicellatum	34.80[d]	4.90[d]	111.70[e]
Cynodon dactylon	24.10[e]	4.40[e]	205.40[c]
Cyperus esculentus	40.50[c]	0.88[f]	22.65[g]
Kyllinga brevifolia	21.50[f]	6.71[c]	226.90[b]
Senna obtusifolia	233.45[a]	80.95[a]	364.40[a]
Leptadenia hastata	0.18[h]	0.47[g]	0.17 [h]
Sphaeranthus angustifolius	68.00[b]	18.00[b]	119.00[d]
Guiera senegalensis	0.45[g]	0.00	82.00[f]
Means	**52.87**	**14.54**	**141.53**
P-Value	**<0.001**	**<0.001**	**<0.001**

[a, b, c, d] ***Means with different superscripts along the same columns differ significantly (P < 0.05)***