African Journal of Food Science and Technology (ISSN: 2141-5455) Vol. 14(8) pp. 01-05, August, 2023
DOI: http:/dx.doi.org/10.14303//ajfst.2023.036
Available online @https://www.interesjournals.org/food-science-technology.html

Research Article

Nutritional characteristics of different parts of *Rhynchosia Minima* as animal feeds

Balgees, Abu Elgasim Atta Elmnan*, Rania, Elzubir Hassan Idriss & Elsmani, Omer Amaseeb

Department of Animal Nutrition, Faculty of Animal Production, University of Khartoum, Khartoum North, Sudan

E-mail: balgeesatta@gmail.com

Mobile Number: +249117870999

Abstract

The study was carried out to determine the nutritive status of leaves, vines, pods and whole plant of *Rhynchosia minima* as animals feed. Samples of each of parts were collected from 50 young plants growing naturally in Shambat Campus-Sudan, during wet season. Parameters measured were: chemical composition, neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), some macro minerals, tannin contents and in-vitro dry matter digestibility (IVDMD). Obtained data were subjected to analysis of variance (ANOVA) for a completely randomize design. The results showed that the leaves had the highest crude protein content (16.24 %), nitrogen free extract (51.47%) and IVDMD (64.90%). Whole plant recorded the highest content of ash (8.24) and all of the studied macro-minerals. While, vines had the highest values of crude fiber (27.97%) and cell constituent, pods had the highest value of ether extract (2.34) and tannins (3.90%). The study concluded that the different parts of *Rhynchosia minima* tree had a great amount of nutrients potential as livestock feed with superior ranking for leaves and whole plant.

Keywords: *Rhynchosia minima*, Nutritive values, Tannin, IVDMD.

INTRODUCTION

Sudan has various environmental regions that allow different types of plants to grow naturally, which can play a serious role for offering nutrients requirements of different kinds of animals (FAO, 2010). Sudan has 110 million livestock, consist of 41.12 million sheep, 32.4 million goats, 32.08 million cattle and 4.9 million camels (MARF, 2021). The available resources of feed for these large numbers of livestock include natural pastures, crop residues and agro-industrial by-products. Although ranges and pasture can offer and support feed for a large number of livestock, the nutritive value of these resources in the Sudan is greatly affected by seasonal changes. There is usually adequate forage of fair to good nutritive value in the wet season, but in the dry season available forage from natural pastures are usually inadequate both in terms of quality and quantity to meet even the maintenance requirements of livestock (Atta Elmnan & Dawood 2011; Atta Elmnan et al., 2022).

Because the fodder trees have a great potential for alleviating some of the feed shortage and nutritional deficiencies during harsh environmental conditions Atta Elmnan & Ali (2020), Atta Elmnan et al., (2022), the fodder trees are recognized as important components of animal feeding, particularly as suppliers of protein in the different animal production system.

Rhynchosia minima is a member of the Leguminosae (Fabaceae) family, it found with adequate density in different regions of the Sudan (FAO, 2010). In Sudan there are no studies dealing with its nutritive value as animal feed. Therefore, this study was carried out to determine

Received: 20-July-2023, Manuscript No. AJFST-23-111226; **Editor assigned:** 24-July-2023, Pre QC No. AJFST-23-111226 (PQ); **Reviewed:** 05-Aug-2023, QC No. AJFST-23-111226; **Revised:** 14-Aug-2023, Manuscript No. AJFST-23-111226 (R); **Published:** 18-Aug-2023

Citation: Balgees, Elmnan, Rania, et al (2023). Nutritional characteristics of different parts of *Rhynchosia Minima* as animal feeds. AJFST: 036.

the nutritive status of leaves, pods, vines and whole of *Rhynchosia minima*, in term of chemical composition, macro-minerals (Ca, Na, Mg, K and P), anti-nutritional factor (tannin) content and *In vitro* dry matter digestibility as animal feeds.

MATERIALS AND METHODS

Sample collection and preparation

Samples of pods, leaves and vines of *R. minima* were collected during wet season from 50 young plants growing naturally in Shambat campus. The samples were picked by hand from the branches at top, middle and the bottom of the different trees. Samples of different parts were separately air dried in shaded place, milled to pass through a 1mm screen, and then were kept in paper bag for further analysis.

Laboratory analysis

Laboratory analysis was carried out at the Animal Nutrition laboratory, Department of Animals Nutrition, Faculty of Animal Production - University of Khartoum.

Chemical Analysis

Proximate analysis was determined according to (AOAC, 2019). Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) were analyzed according to (Van Soest et al., 1991). The nitrogen free extract (NFE) was calculated as follow:

NFE %(DM) = DM - (EE%+CP%+CF%+ash %).

Macro minerals determination

Samples to determine minerals were extracted according to the method described by Pearson (1981). Each sample was burnt in muffle furnace at 550°C, then 10 ml of NHCL was added, after that solution was carefully filtered in a 100ml volumetric flask and finally distilled water was added to make up to the mark. Potassium (K) and Sodium (Na) were determined by AOAC (2019) method using flame photometer. Calcium (Ca) and Magnesium (Mg) levels were carried out according to Chapman and Pratt (1982) by titration method. Phosphorus (P) level was carried out according to the method described by Champ and Pratt (1982) by atomic absorption spectrophotometer.

In-Vitro dry matter digestibility

The dry matter digestibility of the samples was determined using the procedure described by Tilley and Terry (1963).

Tannin determination

Quantitative estimation of tannin was carried out using the modified vanillin-HCL method according to FAO (1989). For this estimation a standard curve was made and the absorbance was read at 500nm using spectrophotometer (JENWAY 6305, UV). The absorbance read was used to determine tannin from the standard curve and was expressed as a percent.

Statistical analysis

The data were subjected to analysis of variance for a completely randomized design (Steel & Torrie 1980). Where the F test was significant, the treatment means were compared using least significant difference (LSD).

RESULTS

Chemical composition

Table 1 shows the dry matter (DM), ether extract (EE), crude protein (CP), crude fiber (CF), ash and nitrogen free extract (NFE) contents of different parts of *Rhynchosia minima*. The results revealed that the DM, EE, CP, CF, ash and NFE, were significantly different ($P<0.01$). The CP content showed a significant variation among the different parts of *R. minima* and can be ranked as follow: leaves, whole plant, pods and vines. The highest percentage of CF and EE were recorded by the vines and pods, respectively. The highest content of NFE was found in the leaves and vines, while the lowest was found in whole plant and pods. For DM, it was high in vines followed by leaves, whole plant and then the pods. The high content of ash was recorded by the whole plant and the low content was recorded by the pods.

Cell wall constituents

Table 2 shows the neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) contents of different part of *Rhynchosia minima*. Vines had the highest NDF, ADF and ADL content (59.60, 48.23 and13.84%) while leaves had the lowest content (43.51, 29.90and6.76%) respectively.

Macro-minerals content

Macro-minerals composition of different part *Rhynchosia minima* (pods, leaves and vines) was presented in **Table 3**. Ca content was ranged from 0.93% in whole plant to 0.51% in pods. Na content was ranged from 0.12% in whole plant to 0.04% in the vines. Mg content was ranged from 1.8% in the pods to 0.15% in the vines. K and P content were ranged from 3.14% and 0.39% in whole plant to 0.68% and 0.12% in the leaves.

Tannin content and *In-vitro* dry mater digestibility

Table 4 shows the tannin content of different part of *Rhynchosia minima* (pods, leaves and vines and whole plant). There were significant differences ($P<0.05$) among different parts of the plant. The high tannin content was

Table 1. Chemical Composition % of Pods, Leaves and Vines of *Rhynchosia minima.*

Part	DM	CP	CF	EE	Ash	NFE
Whole	95.78b	15.40a	25.20 b	2.09b	8.24a	44.72^{c}
Pods	94.19c	12.78b	22.20c	2.34a	5.13d	49.13^{b}
Leaves	95.81b	16.24a	19.02d	1.91c	7.17c	51.47^{a}
Vines	96.45a	10.80c	27.97a	1.76d	7.60b	51.09^{a}
SEM	0.06	0.32	0.31	0.03	0.06	0.18

DM: Dry meter; CP: Crud protein; CF: Curd fiber; EE: Ether extract; Ash: Ash; NFE: Nitrogen free extract, means with different superscripted are significantly (P≤0.05) differed, SEM: stander error of mean.

Table 2. Cell constituents' % of Pods, Leaves and Vines of *Rhynchosia minima.*

Part	NDF	ADF	ADL
Whole	58.48b	35.05b	9.69^{b}
Pods	42.03d	31.52c	6.97^{c}
Leaves	43.51c	29.90c	6.76^{c}
Vines	59.60a	48.23a	13.84^{a}
SEM	0.16	0.47	0.35

NDF: Neutral detergent fiber; ADF: Acid detergent fiber; ADL: Acid detergent fiber; means with different superscripted are significantly (P≤0.05) differed, SEM: stander error of mean.

Table 3. Some macro-minerals (%) content of different parts of *Rhynchosia minima.*

Part	Ca	Mg	Na	K	P
Whole	0.93a	1.80a	0.12a	3.14a	0.39^{a}
Pods	0.51c	1.05b	0.07b	2.05c	0.22^{c}
Leaves	0.81b	0.95b	0.08b	0.68d	0.12^{d}
Vines	0.85ab	0.15c	0.04c	2.87b	0.32^{b}
SEM	0.03	0.04	0.06	0.03	0.03

Means with different superscripted are significantly (P≤0.05) differed, SME: Stander error of mean.

Table 4. Tannin content and IVDMD (%) of pods, leaves and vines of *Rhynchosia minima.*

Part	Tannin	IVDMD
Whole	1.97b	64.90^{a}
Pods	3.9a	59.60^{b}
Leaves	0.60c	63.20^{a}
Vines	1.97b	58.25^{b}
SEM	0.05	0.91

IVDMD: In-vitro dry matter digestibility, a, b and c: values in the same column with different-superscripts are significantly different (P≤0.05) and SEM: stander error and means.

recorded by the pods (3.9%) and the low content was recorded by the leaves (0.6%).

Among the different part of the *Rhynchosia minima*, the highest value of *In-vitro* dry matter digestibility (IVDMD) acquired by the whole plant and leaves while the vines and pods recorded the lowest value (Table 4).

DISCUSSION

The multiple purposes trees are being used naturally as a fodder tree in tropical Africa including Sudan and many other countries around the world (Atta Elmnan et al., 2022). In the present study, random samples of different parts of *Rhynchosia minima* which are consumed indiscriminately as fodder by grazing ruminants were evaluated for their chemical composition to evaluate their nutritional status.

The chemical composition of the different parts of *Rhynchosia minima* showed almost significant variations in all constituents being studied.

Despite of close percentage values of DM in the samples, yet they were significantly different (P<0.05), which implies that the pods had relatively high moisture content as it had a lower DM compared to those of other parts. This may be due the status of the pods which were green at the time of sampling and in normally the vines had lower moisture than other parts of plant. This result agreed with Atta Elmnan & El amin (2015) who stated that, dry matter yield varies with different plant parts.

Of the different parts investigated, the leaves seemed to contain high nutritive value as reflected in having high content of CP, NFE and it contained low CF content compared to the pods, whole plant and vines. This result was similar to results stated by Atta Elmnan & El amin (2015); Atta Elmnan et al., (2022) who stated that the leaves contained more CP than the other parts. Leaves considered as a good source of crude protein, and can be used as an important source of nitrogen for enhanced rumen microbial activity and by-pass protein (Atta Elmnan et al., 2011). The CP in present study showed high levels than the critical minimum level required by (8g/kg CP) the most animals' species (Kamalak et al., 2004). Moreover, different parts of *Rhynchosia minima* examined in this study have shown that the CP content was sufficiently high to warrant consideration of them as protein supplement to low quality diet during dry season.

Moreover, leaves showed a lower content of CF compared to other parts might explain its high content of CP as well as NFE. This could also be confirmed by having lower percentages of NDF, ADF and ADL. On the other hand, the vines significantly had higher crud fiber (27.97%) than the other parts. This result was in the same line with results obtained by Idris et al., (2011), Atta Elmnan and El amin (2015), Atta Elmnan et al., (2022) who reported that vines had higher CF content than other parts of the plant. CF content of browse shrubs and trees is usually lower than that for tropical grasses and it is a good source to activate fermentation in rumen (Atta Elmnan et al., 2009, 2011, 2013; Dambe et al., 2015).

Analysis of the data indicated that there were significant differences among the plant parts in EE. The high concentration of lipids correlated directly to its concentration in plant tissue especially in seeds and part of plant contaminated with bacteria or fungi that can accomplish the complete degradation of dead material of both plants and animal (Begon et al., 1990).

The highest NFE content was found in the leaves and vines, while the lowest was found in whole plant and pods. This is because starch in the plant usually stored in the leaves, green and semi green vines. These results were in the same line with results reported by Atta Emnan and El amin (2015) who stated that the high content of NFE was found in leaves. NFE content of the different parts of the plant in the current study showed a good potential as source of carbohydrate for feed.

Regarding the ash content of pods of this study, it almost had low values of those of the vines, whole plant and leaves which implies that it could contain a lower minerals content compared to contents of the remaining samples. In this context, the variation in macro minerals content in the, vines and leaves of *Rhynchosia minima* was slight and the whole plant showed higher mineral values for Ca, Mg, and K, and this probably could explain it's a higher ash content compared to the other parts of plant. Moreover, Ca content of different parts of *Rhynchosia minima* in the present study showed high levels than the critical minimum level requirement of growing cattle (0.12 -0.44%), lactating dairy lambs (0.09-0.37%) according to (ARC, 1980). This result may be due to the fact that the plant grows in heavy clay soils, particularly those high in lime and phosphorus.

In the present study, it was evident that the overall *In vitro* dry matter digestibility of whole plant and leaves of *Rhynchosia minima* was higher when compared to other parts of plant.

These results were in the same line with findings reported by Atta Elmnan and El amin (2015); Atta Elmnan et al., (2022) who reported that the leaves of legumes tree had the highest IVDMD values than the other parts of the plants. This response could be due to the fact that foliage legume provide nitrogen, energy and vitamins which improved N supply for rumen microbial resulting in an increase of microbial population leading to an increase in IVDMD. Atta Elmnan & Awad (2018) reported that the raise in ruminal ammonia N status enhances microbial activity, resulting in greater DM digestibility. Njidda & Nasiru (2010); Atta Elmnan et al., (2022) found that there was appositive correlation between CP content and dry matter digestibility of some legumes tree.

The high digestibility of whole plant and leaves may strengthen their potential use as feed for ruminants whether being used alone as a feed or in concentrate feed containing different nutrients. This potential use could be strengthened even further because of its estimated high content of CP, NFE, slightly less ash percentage and the moderate percentage of NFE compared to those in the other two samples.

The low IVDMD of vines is more likely to be due to the presence of a relatively high percentage of CF, NDF, ADF and ADL. The previous components were reported to produce a negative influence on the digestibility of the diet. Atta Elmnan et al., (2007, 2016, and 2018) and Atta Elmnan & Ismail (2019) reported that the increases of CF content in the diet resulted in decreases of DM digestibility.

Moreover, the relatively high digestibility showed by the studied samples of the present study might be influenced by presence of relatively low percentages of tannins content. The tannin level must be not exceed 5% and this level have advantage result in preventing bloat and providing valuable rumen bypass protein for the animal by reducing rumen degradation of protein (Atta Elmnan & Ali 2020).

Citation: Balgees, Elmnan, Rania, et al (2023). Nutritional characteristics of different parts of *Rhynchosia Minima* as animal feeds. AJFST: 036.

CONCLUSION

The result of this study showed that the different parts of *Rhynchosia minima* had appreciable amounts of nutrients and it could be used as rumin ants' feeds. Moreover, according to their nutrients content, tannin and IVDMD the different parts could be ranked as follow: leaves, whole plants, pods and vines.

REFERENCES

AOAC (2019). Official methods of chemical analysis association of official agricultural chemists, 21st edition Washington, DC.

ARC (1980). The nutrient requirements of ruminant livestock: Technical review. 73-310.

Atta Elmnan AB, Ali (2020). *In-vitro* dry matter digestibility and *in vitro* gas production of some acacia seeds treated with sodium hydroxide and poly ethylene glycol. Pak J Nutr.19: 381-387.

Atta Elmnan BA & Awad HM (2018). Effect of supplementation different levels of cheese whey to dietary treated baggase on in-vitro nutrients digestibility, rumen environment and gas production. J Vet Med Anim Prod. 8.

Atta Elmnan BA & Dawood MH (2011). Nutritive evaluation of some pasture plants in early and late rainy season in Mosai (Southern Darfur State). Austr J Basic and Appl Sci. 5: 2065-2070.

Atta ELmnan BA & EL Amin MF (2015). Nutritive characteristics of seeds, viness, leaves and seed cake of *Moringa oleifera* Tree. Global J Ani Sci Res. 3: 763-772.

Atta Elmnan BA & Reem A Ismail (2019). *In Vitro* digestibility and *in situ* degradability of sugarcane bagasse treated with urea as energy source in total mixed ration for goat. Online J Anim Feed Res. 9: 86-91.

Atta Elmnan BA, Abd Elrahman FA, Fadal Elseed AMA (2022). Chemical Composition and *In- vitro* crude protein digestibility of some parts of *Sclerocarya birrea* tree. Afr J Food Sci Techno. 13: 26.

Atta Elmnan BA, FadalElseed AM, Salih AM (2007). Effect of urea or ammonia solution on bagasses chemical composition and rumen digestibility of bagasse. J App Sci Res. 3: 1359-1362.

Atta Elmnan BA, FadalElseed AM, Salih AM (2011). Effect of supplementing a basal diet with treated or untreated bagasse with different level Albizialebback on intake, digestibility, and rumen fermentation. Pakistan J Nut. 10: 1149-1153.

Atta Elmnan BA, FadalElseed AMA, Mahala AG, Amasiab EO (2013). *In situ* degradability and *in vitro* gas production of selected multipurpose tree leaves and alfalfa as ruminant feeds. World's Vet J. 3: 46-50.

Atta Elmnan BA, Fadal Elseed AM, Salih AM (2009). Effect of ALbizia lebback or wheat bran supplement on intake, digestibility, and rumen fermentation of ammoniated baggase. J App Sci Res. 5: 1002-1006.

Begon M, Harper JL, Townsend CR (1990). Ecology. individuals, populations and communities. Blackwell scientific publications.

Chapman HD & Pratt PF (1982). Methods of analysis for soil, plant and water.

Dambe LM, Mogotsi K, Odubeng M, Kgosikoma OE (2015). Nutritive value of some important indigenous livestock browse species in semi-arid mixed Mopanebushveld, Botswana. Livest Res Rural Dev. 27: 1-10.

FAO (1989). Manuals of food quality control: Food analysis general techniques additives contamination.

FAO (2010). Crop and food security assessment mission to Ethiopia. Food and Agriculture Organization of the United Nations, Rome.

Idris S, Ndamitso MM, Yisa J, Dauda BEN, Jacob JO (2010). The approximate and mineral composition of the leaves and viness of Balanitesaegytiaca. Int J App Bio Res. 2: 76-87.

Kamalak A, Canbolat O, Gurbuz Y, Ozay O, Ozkan O, et al (2004). Chemical composition and *in-vitro* gas production characteristics of several tannin containing tree leaves. Livest Res Rural Dev. 16: 60-67.

MARF (2021). Ministry of animal resources and fisheries. Statistical bulletin for animal resources. 7-12.

Njidda AA & Nasiru A (2010). *In vitro* gas production and dry matter digestibility of tannin-containing forages of semi-arid region of north-eastern Nigeria. Pakistan J Nutr. 9: 60-66.

Pearson, D (1981). General methods in chemical analysis of foods. 11.

Steel RGD & Torrie JH (1980). Principles and pro-cedures of statistics: A biometrical approach.

Tilley JMA & Terry RA (1963). A two-stage technique for the *in vitro* digestion of forage crops. Grass Forage Sci. 18: 104-111.

Van Soest PJ, Robertson B, Lewis BA (1991). Method for dietary fiber, neutral detergent fiber and non- starch polysaccharides in relation to animal nutrition. J Dairy Sci. 74: 3583-3597.

Citation: Balgees, Elmnan, Rania, et al (2023). Nutritional characteristics of different parts of *Rhynchosia Minima* as animal feeds. AJFST: 036.