# aJava

Asian Journal of Animal and Veterinary Advances

Academic
Journals Inc.

www.academicjournals.com

OPEN ACCESS Asian Journal of Animal and Veterinary Advances

ISSN 1683-9919
DOI: 10.3923/ajava.2018.25.29

# Research Article
# Nutritional Evaluation of Sweet Potato Vines from Twelve Cultivars as Feed for Ruminant Animals

Mohammed Baba, Aminu Nasiru, Inusa Saleh Karkarna, Ibrahim Rakson Muhammad and Nuhu Bello Rano

Department of Animal Science, Bayero University, Kano, Nigeria

## Abstract

**Background and Objective:** Considerable quantities of crop residues by uncommon agro-industrialist are generated every year in most developing countries in the tropics and subtropics. Therefore, there is a growing interest in most countries to use the low cost alternative feedstuff sources for animals. This experiment evaluated sweet potato vines from twelve cultivars for nutritive value and anti-nutritional substances. **Materials and Methods:** Samples for the analysis were obtained from the Agronomy Department from pilot study plots established at five villages in five local government areas of Kano state, Nigeria. Samples were analyzed in triplicates in a completely randomized design after oven drying at 70°C for 48 h and ground to pass through a 2 mm sieve using a hammer mill. **Results:** The results indicate significant differences ($p<0.05$) among all the parameters analyzed or calculated. Crude protein was higher ($p<0.05$) in the cultivar Lourdes (20.58%) while NFE was greatest ($p<0.05$) in Danchina (51.51%). The NDF was significantly lower ($p>0.05$) in cultivar A0305. In contrast, dry matter intake as a percentage of body weight and relative feed value were significantly higher ($p<0.05$) in A0305 (3.94 and 208.54, respectively). **Conclusion:** All the cultivars demonstrated excellent feeding potential in terms of quality. However, comparatively it would appear that A0305 had a higher feeding value, given its relatively lower NDF and higher feed intake as well as relative feed value.

Key words: Potato vines, crude protein, supplement, dry season, relative feed value

Received: August 28, 2017 Accepted: October 02, 2017 Published: December 15, 2017

Citation: Mohammed Baba, Aminu Nasiru, Inusa Saleh Karkarna, Ibrahim Rakson Muhammad and Nuhu Bello Rano, 2018. Nutritional evaluation of sweet potato vines from twelve cultivars as feed for ruminant animals. Asian J. Anim. Vet. Adv., 13: 25-29.

Corresponding Author: Mohammed Baba, Department of Animal Science, Bayero University, Kano, Nigeria Tel: 09091532475



Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

## INTRODUCTION

Majority of small-scale farmers in Africa and Asia plant sweet potato (*Ipomoea batatas* L. (Lam)) for tubers as a source of energy/or fodder as a source of protein and vitamins for humans[1] and livestock[2]. The selection and adoption of sweet potato cultivar with the potential as animal feed will assist a great deal in mitigating the pressure on conventional feed resources owing to competition by humans. Furthermore, the utilization of sweet potato vines in livestock feeding could help to reduce some of the nutritional problems associated with the dry season feeding of livestock during which time the crude protein content of native grasses falls below the minimum threshold level for animal maintenance and production. Increasing the amount of sweet potato vines in napier based diets improved crude protein, feed intake and rumen $NH_3$-N production[3]. Age at harvest is one of the major management factors affecting the yield and tuber quality of sweet potatoes[4].

One of such alternative feedstuffs is the potato vine that can remain green during a long period and be fed without any form of treatment as it is applicable to cereal crop residues[5]. Potato is one of the most important food crops in developing countries, such as Nigeria. Consequently, there is a huge amount of potato vines (plant residues after harvest) produced and left over after harvest. Traditionally, potato has been grown exclusively for the production of tubers and the vines have been considered as a waste byproduct and therefore thrown away. This is while vines could be fed to livestock and the tubers used for human consumption. It has been shown that the leaves make up approximately half of the potato plant biomass[4]. In developing countries, potato vines are mainly used as animal feed wherever they are produced[6]. Potato vines could, therefore, be an important resource as ruminant livestock feed in the developing countries. Previously, the sweet potato vines has been fed successfully to dairy cattle[7] and fattening steers[8]. Besides, the chemical composition and nutrient digestibility of the potato vine has been compared with alfalfa hay as the dominant reference forage in ruminant nutrition. The objective of the study was to evaluate the nutritive value and antinutritional factors of sweet potato vines from twelve cultivars.

## MATERIAL AND METHODS

The experiment was conducted during the rainy season between July-October of the year 2016. Samples of sweet potato vines were obtained from twelve cultivars of sweet potato (Melinda, Danchina, Centennial, Lourdes, Gloria, Mother's delight, Delvia, T1Z1, King J, A0305, Sumhia and Jane) planted by Agronomy Department of Bayero University, Kano at five different villages, namely Bagwai, Serina, Fagam, Gara and Gulu located in the following Local Government areas of Kano state Bagwai, Garko, Kibiya, Madobbi, Gara and Rimingado, respectively. The vines were harvested at 9 months post planting.

**Experimental location:** Kano lies between longitude 9°31' and 12°30' North and latitude 9°30' and 8°42' East in the Sudan Savannah ecological zone of Nigeria. The zone is characterized by two distinct seasons namely, wet season (May-September) and dry season (October-April). Mean annual rainfall ranges from 500-1000 mm and temperature from 21-39°C[9].

**Treatments and experimental design:** A single plot was established for each of the twelve cultivars of sweet potato in each of the locations. Each location therefore constituted a block. The experimental design was a randomized complete block design. The treatments were the twelve varieties of sweet potato vines and each treatment was replicated 4 times. Laboratory analysis was carried out using 3 replicate samples in a completely randomized design.

**Laboratory analysis:** Triplicate samples of sweet potato vines for each cultivar were oven dried at 70°C for 48 h. The dried samples were ground to pass through a 2 mm sieve. The samples were then used for proximate analysis according to AOAC[10]. Antinutritional factors (tannin, saponin, phytate, oxalate and hydrogen cyanide) were determined using the methods described by Peter-Okechukwu *et al.*[11].

**Calculations:** Other nutritive value parameters (DDM, DMI and RFV) were calculated as thus:

$$\text{DMI} = \frac{120}{\text{NDF \% dry matter basis}^{12}}$$

$$\text{DDM} = 88.9\text{-}(0.779\times\text{ADF \%, dry matter basis})^{12}$$

$$\text{RFV} = \text{DDM \%}\times\text{DMI \%}\times 0.775^{12}$$

Where:

DMI = Dry matter intake
DDM = Digestible dry matter
RFV = Relative feed value

**Statistical analysis:** Data were analyzed with the aid of Analysis of Variation (One way ANOVA) using SAS 2009 (Version 9.2 TSIMO, CARY, NC, USA)[13]. Differences among means were separated using Duncan's multiple range test at 5% probability level.

## RESULTS

The proximate composition of potato vines is shown in Table 1. Varieties were significantly different (p<0.05) in terms of all the proximate constituents of sweet potato vines evaluated. The values for ash ranged from 5.41% in T10 (A0305) to 10.40% in T4 (Lourdes). Crude protein from 10.82% in T6 (Mother's delight) to 20.58% in T4 (Lourdes). The crude fiber content varied from 21.14% in T9 (King J) to 35.37% in T4 (Lourdes). Ether extract was from 3.90% in T8 (T121) to 6.22% in T5 (Gloria) while NFE was from 27.86% in T4 (Lourdes) to 51.51% in T2 (Danchina).

Fiber fractions and other nutritive value parameters are shown in Table 2. Significant differences (p<0.05) were observed among the different varieties of sweet potato vines. Mean ADF values ranged from 24.25% in T11 (Sumai) to 26.63% in T4 (Lourdes). NDF was from 30.5% in T10 (A0305) to 36.24% in T1 (Melinda). Mean dry matter intake varied from 3.32% in T1 (Melinda) to 3.94% in T10 (A0305). Digestible dry matter value was from 67.74% in T9 (King J) to 70% in (Sumai) while relative feed value was from 176.88% in T1 (Melinda) to 208.54% in T10 (A0305).

The antinutritional factors in sweet potato vines differed significantly (p<0.05) among the cultivars. Tannin content ranges from 0.31% in T12 (Jane) to 1.25% in T5 (Gloria) as shown in Table 3. Saponin from 0.64% in T9 (King J) to 2.46% in T1 (Melinda). Phytate varied from 19.59 mg/100 g in T12 (Jane) to 57.29 mg/100 g in T4 (Lourdes). Oxalate ranged from 8.38 mg/100 g in T2 (Danchina) to 29.42 mg/100 g in T3 (Centennial) and HCN from 2.30 mg/100 g in T5 (Gloria) to 5.73 mg/100 g in Centennial.

Table 1: Proximate composition (%) of sweet potato vines from 12 cultivars

| | Ash | Moi | CP | CF | EE | NFE |
|---|---|---|---|---|---|---|
| T1 (Melinda) | $9.83^{a}$ | $6.00^{d}$ | $13.40^{d}$ | $30.62^{bc}$ | $4.60^{a}$ | $41.56^{bc}$ |
| T2 (Danchina) | $7.46^{bc}$ | $9.93^{a}$ | $13.74^{e}$ | $23.02^{d}$ | $4.26^{a}$ | $51.51^{a}$ |
| T3 (Centennnial) | $5.53^{d}$ | $9.80^{a}$ | $14.05^{e}$ | $30.65^{bc}$ | $5.79^{a}$ | $43.97^{ac}$ |
| T4 (Lourdes) | $10.40^{a}$ | $8.00^{b}$ | $20.58^{a}$ | $35.37^{a}$ | $5.79^{a}$ | $27.86^{f}$ |
| T5 (Gloria) | $5.84^{cd}$ | $6.64^{cd}$ | $17.43^{bcd}$ | $33.42^{ab}$ | $6.22^{a}$ | $36.40^{de}$ |
| T6 (Mothers delight) | $10.11^{a}$ | $7.43^{bc}$ | $10.82^{f}$ | $29.68^{c}$ | $4.51^{a}$ | $44.87^{b}$ |
| T7 (Delvia) | $5.83^{cd}$ | $8.23^{b}$ | $15.31^{cde}$ | $33.77^{ab}$ | $5.92^{a}$ | $40.20^{cd}$ |
| T8 (T121) | $8.79^{ab}$ | $7.33^{bcd}$ | $20.05^{ab}$ | $33.82^{ab}$ | $3.90^{a}$ | $33.43^{e}$ |
| T9 (King J) | $9.23^{a}$ | $10.63^{a}$ | $14.71^{de}$ | $21.14^{d}$ | $3.95^{a}$ | $51.00^{a}$ |
| T10 (A0305) | $5.41^{d}$ | $8.13^{b}$ | $18.04^{abc}$ | $29.00^{c}$ | $4.26^{a}$ | $43.28^{bc}$ |
| T11 (Sumai) | $8.67^{ab}$ | $7.33^{bcd}$ | $15.14^{de}$ | $34.82^{ab}$ | $5.87^{a}$ | $35.81^{e}$ |
| T12 (Jane) | $8.85^{ab}$ | $9.55^{a}$ | $15.31^{cde}$ | $29.17^{c}$ | $4.45^{a}$ | $42.23^{bc}$ |
| p-value | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.5076 | 0.0001 |

Means with different superscripts within the same column are significantly different (p<0.05), Moi: Moisture, CP: Crude protein, CF: Crude fiber, EE: Ether extract, NFE: Nitrogen free extract

Table 2: Fiber fractions dry matter intake (% body weight) digestible dry matter (DDM) and relative feed value (RFV %) of vines from 12 sweet potato cultivars

| | ADF | NDF | DMI | DDM | RFV |
|---|---|---|---|---|---|
| | (%) | | | | |
| T1 (Melinda) | $25.78^{abcde}$ | $36.24^{a}$ | $3.32^{e}$ | $68.82^{bcdef}$ | $176.88^{e}$ |
| T2 (Danchina) | $24.53^{def}$ | $35.09^{ab}$ | $3.42^{cde}$ | $69.79^{abc}$ | $185.28^{cd}$ |
| T3 (Centennnial) | $26.28^{abc}$ | $32.22^{d}$ | $3.73^{b}$ | $68.43^{def}$ | $197.86^{b}$ |
| T4 (Lourdes) | $26.63^{a}$ | $34.90^{abc}$ | $3.44^{cde}$ | $68.16^{f}$ | $181.68^{cde}$ |
| T5 (Gloria) | $25.84^{abcd}$ | $33.78^{c}$ | $3.56^{c}$ | $68.79^{cdef}$ | $189.63^{c}$ |
| T6 (Mothers delight) | $25.17^{bcdef}$ | $35.36^{ab}$ | $3.40^{de}$ | $69.30^{abcde}$ | $182.36^{cde}$ |
| T7 (Delvia) | $26.17^{abc}$ | $31.56^{de}$ | $3.81^{b}$ | $68.52^{def}$ | $202.06^{ab}$ |
| T8 (T121) | $24.92^{cdef}$ | $35.93^{a}$ | $3.34^{e}$ | $69.48^{abcd}$ | $180.02^{de}$ |
| T9 (King J) | $27.16^{a}$ | $34.27^{bc}$ | $3.50^{cd}$ | $67.74^{f}$ | $184.02^{cde}$ |
| T10 (A0305) | $26.44^{ab}$ | $30.50^{e}$ | $3.94^{a}$ | $68.30^{ef}$ | $208.54^{a}$ |
| T11 (Sumai) | $24.25^{f}$ | $35.73^{a}$ | $3.36^{de}$ | $70.00^{a}$ | $182.39^{cde}$ |
| T12 (Jane) | $24.46^{ef}$ | $34.98^{abc}$ | $3.43^{cde}$ | $69.88^{ab}$ | $185.86^{cd}$ |
| p-value | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0001 |

Means with different superscripts within the same column are significantly different (p<0.05), ADF: Acid detergent fiber, NDF: Neutral detergent fiber, DMI: Dry matter intake, DDM: Digestible dry matter, RFV: Relative feed value

Table 3: Antinutritional substances (mg/100 g) in sweet potato vines from 12 cultivar

| | Tannin | Saponin | Phytate | Oxalate | HCN |
|---|---|---|---|---|---|
| T1 (Melinda) | 0.87[bc] | 2.46[a] | 36.70[cd] | 19.43[cd] | 5.13[abc] |
| T2 (Danchina) | 0.69[cd] | 1.26[c] | 46.98[b] | 8.38[f] | 3.86[c] |
| T3 (Centennnial) | 1.06[ab] | 0.96[cde] | 31.37[de] | 29.42[a] | 5.73[a] |
| T4 (Lourdes) | 0.80[c] | 0.75[de] | 57.29[a] | 13.02[ef] | 5.36[ab] |
| T5 (Gloria) | 1.25[a] | 1.69[b] | 28.50[ef] | 20.29[c] | 2.30[d] |
| T6 (Mothers delight) | 0.50[de] | 0.90[cde] | 26.43[ef] | 10.99[ef] | 4.43[abc] |
| T7 (Delvia) | 0.79[c] | 1.06[cd] | 24.34[efg] | 13.59[e] | 4.17[bc] |
| T8 (T121) | 0.38[e] | 1.82[b] | 31.74[de] | 15.32[de] | 4.72[abc] |
| T9 (King J) | 0.79[c] | 0.64[e] | 30.88[de] | 10.64[ef] | 3.90[c] |
| T10 (A0305) | 0.42[e] | 1.27[c] | 21.43[fg] | 23.09[bc] | 4.89[abc] |
| T11 (Sumai) | 1.04[ab] | 0.81[de] | 39.52[c] | 27.29[ab] | 3.77[c] |
| T12 (Jane) | 0.31[e] | 1.01[cde] | 19.59[g] | 10.89[ef] | 4.37[abc] |
| p-value | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0077 |

Means with different superscripts within the same column are significantly different ($p<0.05$)

## DISCUSSION

The results of proximate and fiber analysis as well as other nutritive value indicate potato vines of good feeding quality. The ash contents recorded in the current study were similar to those reported by Yacout *et al.*[14] (8.89-10.74%) for fresh, sundried un-inoculated and inoculated sweet potato vines. The greater ash values recorded by T4 (Lourdes) and Mother's delight (T6) are suggestive of higher mineral content in the vines. The range of crude protein observed in the current study (10.82-20.58) suggests higher crude protein values well above the critical limit of protein requirement by ruminant animals. The protein values were higher than those reported by Yacout *et al.*[14] for fresh, sundried and ensiled potato vines. The seeming difference may be attributed to genotype and environmental condition. The crude fiber values obtained in the present study were higher than those reported by Yacout *et al.*[14]. It will appear that ensiling may have had a depressing influence on the crude fiber content of sweet potato vines. In the same connection, the ether extract values recorded in the current study (3.90-6.22) were greater than the values obtained by Yacout *et al.*[14] (2.58-3.38).The difference may be adduced to the effect of processing on the ether extract content of the vines used by the researcher. The nitrogen free extract values in the current study were lower than those reported by Yacout *et al.*[14] (50.07-60.43). This may probably be due to the correspondingly higher crude fiber reported in this study, which could have masked the available soluble carbohydrate. The acid and neutral detergent fiber values reported in this study were within the range reported by Yacout *et al.*[14].

The higher dry matter intake and relative feed value observed in variety A0305 (T10) may be due to its comparatively lower NDF value among the vine cultivars evaluated. Furthermore, dry matter intake is inversely related to NDF. By and large, the relative feed values of all the cultivars were greater than 151 considered as prime in terms of feed quality[15].

The tannin content recorded in the current study for all the varieties of sweet potato vines was lower than that reported by Yacout *et al.*[14] (2.41-6.19 mg/100 g) for sundried and ensiled materials. This may be due to genotype and environmental effects[14]. Other antinutritional substances, such as saponin, phytate oxalate and HCN, were comparatively higher than the values reported by Yacout *et al.*[14] (0.11-0.42, 2.54-5.63, 1.94-4.86 and 0.49-1.07mg/100 g), respectively. The lower values reported by Yacout *et al.*[14] may be explained in the context of the role of lactic acid bacteria in the solubilization of the aforementioned substances[16]. Other researchers reported even higher values for tannin (9.01 mg/100 g)[17] and HCN (30.24 mg/100 g) in sweet potato (*Ipomoea batatas*) leaves[18].

## CONCLUSION

All the sweet potato vines showed very high potential as livestock feed in terms of nutritive value parameters. However, comparatively, it would appear that A0305 had a higher feeding value, given its relatively lower NDF and higher feed intake as well as relative feed value. In addition, potato vines could be used to supplement protein deficiency in native rangelands during a critical period (the dry season).

## SIGNIFICANCE STATEMENT

This study discovers the potential feeding value of sweet potato vines that could be used to supplement poor quality native grasses of tropical origin during critical period, a situation that impacts negatively on animal production.

## ACKNOWLEDGMENT

The authors gratefully acknowledge the contribution of Centre for Dryland Agriculture of Bayero University Kano in the area of funding for the research from MacArthur grant.

## REFERENCES

1. Larbi, A., I. Etela, H.N. Nwokocha, U.I. Oji and N.J. Anyanwu *et al.*, 2007. Fodder and tuber yields and fodder quality of sweet potato cultivars at different maturity stages in the West African humid forest and savanna zones. Anim. Feed Sci. Technol., 135: 126-138.
2. Farrell, D.J., H. Jibril, R.A. Perez-Maldonado and P.F. Mannion, 2000. A note on a comparison of the feeding value of sweet potato vines and lucerne meal for broiler chickens. Anim. Feed Sci. Technol., 85: 145-150.
3. Kariuki, J.N., S. Tamminga, C.K. Gachuiri, G.K. Gitau and J.M.K. Muia, 2001. Intake and rumen degradation in cattle fed napier grass (*Pennisetum purpureum*) supplemented with various levels of *Desmodium intortum* and Ipomoea batatus vines. S. Afr. J. Anim. Sci., 31: 149-157.
4. Van An, L., B.E. Frankow-Lindberg and J.E. Lindberg, 2003. Effect of harvesting interval and defoliation on yield and chemical composition of leaves, stems and tubers of sweet potato (*Ipomoea batatas* L. (Lam.)) plant parts. Field Crops Res., 82: 49-58.
5. Snyman, L.D. and H.W. Joubert, 2002. The chemical composition and *in vitro* dry matter digestibility of untreated and ammoniated crop residues. S. Afr. J. Anim. Sci., 32: 83-87.
6. Scott, G.J., 1992. Sweet potatoes as animal feed in developing countries: Present patterns and future prospects. FAO Animal Production and Health Paper No. 95, Food and Agriculture Organization of the United Nations, Rome, pp: 183-199.
7. Etela, I., A. Larbi, U.J. Ikhatua and M.A. Bamikole, 2009. Supplementing Guinea grass with fresh sweet potato foliage for milk production by Bunaji and N'Dama cows in early lactation. Livest. Sci., 120: 87-95.
8. Nelson, M.L., J.R. Busboom, J.D. Cronrath, L. Falen and A. Blankenbaker, 2000. Effects of graded levels of potato by-products in barley-and corn-based beef feedlot diets: I. Feedlot performance, carcass traits, meat composition and appearance. J. Anim. Sci., 78: 1829-1836.
9. KNARDA., 2001. Kano agricultural and rural development authority meteorological station reports. Temperatures Record Book and Management Unit, 11, pp: 1-3.
10. AOAC., 1995. Official Method of Analysis. 15th Edn., Association of Official Analytical Chemists, Washington, DC., USA.
11. Peter-Okechukwu, A.I., R.O. Enwereuzoh, A.E. Uzoukwu, S.M. Nze, M.I. Agunwa, F.I. Anagwu and C. Onyemachi, 2015. Effect of fermentation on the anti-nutritional factors and mineral composition of melon seed varieties for ogiri production. Food Sci. Qual. Manage., 43: 98-102.
12. Horrocks, R.D. and J.F. Valentine, 1999. Harvested Forages. Academic Press, London, UK., pp: 13.
13. SAS., 2009. SAS Users Guide Version 9.2. SAS Institute Inc., Cary, NC., USA.
14. Yacout, M.H., A.A. Khayyal, A.M. Shwerab and M.S. Khalel, 2016. Introduce sweet potato vines as good roughage for small ruminants. Ecronicon Vet. Sci., 4: 104-204.
15. Kocer, A. and S. Albayrak, 2012. Determination of forage yield and quality of pea (*Pisum sativum* L.) mixtures with oat and barley. Turk. J. Field Crops, 17: 96-99.
16. Dalie, D.K.D., A.M. Deschamps and F. Richard-Forget, 2010. Lactic acid bacteria-potential for control of mould growth and mycotoxins: A review. Food Control, 21: 370-380.
17. Mbaeyi-Nwaoha, I.E. and V.N. Emejulu, 2013. Evaluation of phytochemical composition and antimicrobial activity of sweet potato (Ipomoea batatas) leaf. Pak. J. Nutr., 12: 575-586.
18. Antial, B.S., E.J. Akpanz, P.A. Okonl and I.U. Umorenl, 2006. Nutritive and anti-nutritive evaluation of sweet potatoes (*Ipomoea batatas*) leaves. Pak. J. Nutr., 5: 166-168.