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Chemical Composition of *Rauvolfia Vomitoria* Leaves as a Feed Resource for Ruminant Species

Ekanem, N. J. [1]; Afolabi, K. D. [1]; Inyang, U. A. [1]; Enyenihi, G. E. [1]; Mbaba, E. N. [1]; Unah, U. L. [1]; Solomon, I. P. [1]; Ebenso, I. E. [1]; Udoh, J. E. [1]; Isaac, L. J. [1]; Eko, P. M. [1]; Assam, E. D. [1]; Jack, A. A. [1]; Okon, I. E. [1]; Etteh, U. D. [1]; Agwu, A. E. [2]; Okon, U. E. [1]; and Udo, A. L. [1]

[1]Department of Animal Science, Faculty of Agriculture, University of Uyo, Uyo, Akwa Ibom State, Nigeria.
[2]Department of Animal Health and Production Technology, Federal Polytechnic Ngodo-Isuochi, Abia State, Nigeria.

Corresponding author: ekanem_n@yahoo.co.uk

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Abstract

Rauvolfia vomitoria is a browse plant with lactogenic properties and it is available all year round. This research sought to evaluate the proximate, minerals, vitamins composition, fibre fractions and anti-nutritional factors present in the leaves of *Rauvolfia vomitoria* (RV). Fresh leaves of RV were harvested and taken to the laboratory immediately for chemical analyses following standard procedures. Results obtained showed that RV contained 19.33 % crude protein, 6.64 % crude fibre, 61.69 % nitrogen free extract, 67.60 mg/100g calcium, 180.11 mg/100g magnesium, 68.31 mg/100g phosphorus, 128.16 mg/100g sodium, 47.93 mg/100g potassium, 18.82 mg/100g vitamin A, 64.74 mg/100g vitamin C, 41.62 mg/100g vitamin D, 20.85 mg/100g vitamin E and 13.26 mg/100g vitamin K. *Rauvolfia vomitoria* leaves also contained 62.91 % neutral detergent fibre, 39.00 % acid detergent fibre, 15.25% acid detergent lignin, 23.75 % cellulose, 23.91 % hemicellulose, 20.04 mg/100g tannins, 3,61 mg/100g saponin, 128.96 mg/100g oxalic acid, 43.18 mg/100g phytic acid and 15.78 mg/100g hydrocyanic acid. These rich chemical constituents of RV leaves will make it to support optimum reticulo-rumen fermentation, digestibility and retention of nutrients which in turn will result in maximum productivity in terms of milk and meat by ruminant animals.

Keywords: *Rauvolfia vomitoria*, Lactogenesis, Minerals, Vitamins, Fibre Fractions, Anti-Nutrient.

Introduction

Rauvolfia vomitoria, is a species of flowering plant belonging to the family Apocynaceae, the English names of *Rauvolfia vomitoria* are swizzle stick, African snake root and poison devil's pepper. It is popularly called "Asofeyeje" in Yoruba language, "Akanta" in Igbo language (Okereke *et al.* (2015) and "mmongeba ebot" (transliteration: milk of goat) in Efik/Ibibio language (Ekong *et al.*, 2015; Bassey *et al.*, 2014). *Rauvolfia vomitoria* is a shrub or a tree. It grows to a height of 0.5 - 40 metre. The tree is harvested from the wild for use as a medicinal plant, fodder for livestock and for extraction of bioactive compounds such as

reserpine, ajmalicine and serpentine (Fern, 2024; Olajide and Etigale, 2017; Ekong *et al.*, 2015).

Rauvolfia vomitoria (RV) plant has a good number of phytochemicals which are beneficial to human health and disease prevention. The leaves are utilized medically as sedative, tranquilizer and anthelminthic (Olajide and Etigale (2017). *Rauvolfia vomitoria* root extract is loaded with phytochemicals and it exerts several pharmacological properties like anti-inflammatory, antioxidants, hepatoprotective, anti-hyperglycaemic, antifungal, antiviral, hypolipidaemic, cytotoxic etc. *Rauvolfia vomitoria* contains many useful alkaloids which possess antihypertensive, neuro-protective, antipsychotic and anti-inflammatory properties (Okon *et al.*, 2021; Yu *et al.*, 2013). *Rauvolfia vomitoria* has strong anti-diabetic and antidiarrheal properties (Akpojotor, and Ebomoyi, 2021; Odenigbo *et al.*, 2020). *Rauvolfia vomitoria* as a medicinal plant has shown great potentiality in the management of sickle cell disorders (Abere *et al.*, 2014).

Ajala *et al.* (2016) assessed the effectiveness of indigenous knowledge practices among sheep and goat farmers in Igbomina Land in Osun and Kwara States, Nigeria. They assessed the use of locally available ingredients including the leaves, fruits, barks and roots of some plants containing phytochemicals for the treatment of ailments or diseased conditions in sheep and goats by rural farmers. One of such plants was Oloora (*Rauvolfia vomitoria*), whose bark was ground and mixed with palm oil for the treatment of ingestion of poisonous plants by sheep and goats. *Rauvolfia vomitoria* release a white (milky) exudate or latex when cut. *Rauvolfia vomitoria* leaves are commonly used in the villages in southern Nigeria (Akwa Ibom state inclusive) as favourite forages for lactating goat and sheep as it is believed to increase milk let down and yield (Bassey *et al.*, 2014).

There is dearth of information on the chemical composition of *Rauvolfia vomitoria* leaves. The objective of this research therefore was to evaluate the proximate, minerals assays, vitamins concentration, fibre fractions and anti-nutritional factors in the fresh leaves of *Rauvolfia vomitoria* to ascertain its nutritional potential as a veritable resource for the feeding of livestock all year round and for the enhancement of animal products in terms of quality and quantity.

Materials and Methods

The experiment was conducted at the Dairy Unit, Department of Animal Science, University of Uyo Annex Campus, Uyo, Akwa Ibom State. University of Uyo lies between latitude 05 02′ North and longitude 07 56′ East. Uyo has natural day length of 12 – 13 hours. The monthly mean minimum temperature ranges from 21.3 C to 24.9 C and the monthly mean maximum temperature ranges from 28.4 C to 34.5 C. The annual mean rainfall ranges between 2000 – 3000 mm. Relative humidity ranges from 78 – 93 %, (The Meteorological Unit, Geography Department, University of Uyo).

Fresh *Rauvolfia vomitoria* leaves was harvested during the month of April and taken to the laboratory for the determination of proximate, minerals composition, vitamins concentration, fibre fractions and anti-nutritional factors following standard procedures. The dry matter and proximate composition (crude protein, crude fibre, ash and ether

extract was determined according to the procedure of AOAC (2010). Nitrogen free extract was calculated as 100 – (crude protein + crude fibre + ether extract + ash). The RV leaves mineral constituents were analyzed by the dry ash extraction method, after which specific mineral elements were analyzed following standard procedures. Calcium and magnesium concentrations were analyzed by the Versanale EDTA complexiometric titration method (Pearson, 1976). Phosphorus was determined by the vanadomolybdate (yellow) spectrophotometry method. Iron (Fe) was determined using the atomic absorption spectrophotometer (AAS); Buck 200 AAS Model. Sodium and potassium were analyzed by flame photometry (AOAC, 2010). Vitamins concentrations in the RV leaves were determined following the procedure of AOAC (2010). The neutral detergent fibre, acid detergent fibre and acid detergent lignin fractions of the RV leaves were determined following the procedures of van Soest *et al.* (1991). Cellulose was obtained as the difference between acid detergent fibre (ADF) and acid detergent lignin (ADL). The difference between neutral detergent fibre (NDF) and ADF gave the hemicellulose proportions present in the RV leaves. The Folin-Dennis Spectrophometric method as described by Pearson (1976) was used to determine the tannins concentration of the RV leaves. The saponin content of the RV leaves was analyzed according to the Double Solvent Extraction Gravimetrical Method as outlined by Harborne (1973). The phytic acid concentration of the RV leaves was assessed according to the procedure described by McCance and Widdowson (1953). The Nessler's Colorimeter Method procedure was followed for the analyses of the concentrations of Ammonia nitrogen (NH_3N) in the leaves (AOAC, 2010).

Results and Discussion

The proximate composition of *Rauvolfia vomitoria* leaves is as shown on Table 1. The crude protein (CP) of the leaves was 19.23 %. Other proximate constituents were 6.64 % crude fibre (CF), 3.96 % ether extract (EE), 8.38 % ash, 61.69 % nitrogen free extract (NFE) and 359.72 Kcal energy contents.

Table 1: Proximate composition (%) of *Rauvolfia vomitoria* leaves

Parameters	*Rauvolfia vomitoria* leaves
Dry matter	55.44
Crude protein	19.33
Crude fibre	6.64
Ether extract	3.96
Ash	8.38
Nitrogen Free extract	61.69
Energy (Kcal)	359.72

The crude protein contents (19.33 %) of RV leaves obtained in this study was a little higher compared to the CP of 18 % for RV leaves reported by Larbi *et al.* (1993) who analyzed browse plants cultivated at Abak Local Government Area (L.G.A.) of Akwa Ibom state. They

also reported a CP of 11 % CP for *Manniophyton fulvum*, 17 % for *Alchornea cordifolia*, 21 % for *Baphia nitida*, 23 % for *Gliricidia sepium* and 24 % for *Leucaena leucocephala* among other browse plants (Larbi *et al.*, 1993). The CP contents obtained in this study was however lower than the CP of 25.88 % reported by Bassey *et al.* (2014) for RV harvested at Itu L.G.A., Akwa Ibom state and sundried for 4 days. They also reported CP contents of 14.65 % for *Palisota hirsute*, 17.06 % for *Spondias mombin* and 18.81 % for *Manniophyton fulvum*.

Similarly, the CP contents obtained in this study was lower than the CP of 23.56 % reported by Okereke *et al.* (2015) for sun dried RV leaves harvested at Ebonyi state, Nigeria. Other authors reported the following CP contents in the leaves of the following browse plants: 16.10 % in *Alchornea cordifolia* (Ahamefule *et al.*, 2006), 17.15 % in *Manniphyton fulvum* (Ahamefule *et al.*, 2006), 16.80 % in *Gmelina arborea* (Ahamefule *et al.*, 2006), 28.86 % in *Leucaena leucocephala* (Asaolu *et al.*, 2012), 21.64 – 23.83 in *Gliricidia sepium* (Asaolu *et al.*, 2012; Galindo *et al.*, 2014), 18.60 % and 22.05 % in *Enterolobium cyclocarpum* by Babayemi (2006) and Ekanem *et al.* (2020). The CP value for RV leaves obtained in this research was therefore within the range of values reported by other authors and also by far exceeded the 10 – 12 % CP requirements for ruminants (ARC, 1985). The crude fibre (CF) contents (6.64 %) of RV leaves obtained in this study was lower than the 21.00 % reported by Bassey *et al.* (2014) and 12.73 % reported by Okereke *et al.* (2015) for RV leaves. Higher CF contents of 13.00 % in *Manniophyton fulvum*, 20 % in *Spondias mombin* and 28.57 % in *Palisota hirsute* have been reported by Bassey *et al.* (2014). The percentage ether extract (3.96 %) obtained in this study was higher to the 2.78 % ether extract for RV leaves reported by Okereke *et al.* (2015) but lower than the 10.54 % reported by Bassey *et al.* (2014).

Table 2 shows the mineral composition of *Rauvolfia vomitoria* leaves; ranging from 0.23 mg/100g Iron (Fe) to 180.11 mg/100g concentration of magnesium.

Table 2: Mineral composition (mg/100g) of *Rauvolfia vomitoria* leaves

Parameters	*Rauvolfia vomitoria* leaves
Calcium	67.60
Magnesium	180.11
Phosphorus	68.31
Iron	0.23
Sodium	128.16
Potassium	47.93

The calcium contents (67.60 mg/100g) for RV leaves obtained in this research was higher compared to the 14.00 mg/100g calcium reported by Bassey *et al.* (2014). The authors (Bassey *et al.*, 2014) also reported calcium contents of 0.06 mg/100g in *Manniophyton fulvum*, 1.20 mg/100g in *Spondias mombin* and 200.00 mg/100g in *Palisota hirsute*. Galindo *et al.* (2014) reported varying calcium concentrations in these browses: 1.18 mg/100g in fresh leaves of *Leucaena leucocephala*, 1.48 mg/100g in dried *Gliricidia sepium* leaves, 2.28 mg/100g in the leaves of *Azadirachta indica* and 1.28 mg/100g in dried *Moringa oleifera* leaves.

Magnesium concentration of 180.11 mg/100g obtained in *Rauvolfia vomitoria* leaves in this research was also higher to the 28.80 mg/100g reported by Bassey *et al.* (2014) for same browse plant. They also reported magnesium concentration of 0.29 mg/100g in *Spondias mombin*, 0.24 mg/100g in *Manniophyton fulvum* and 74.40 mg/100g in *Palisota hirsute* (Bassey *et al.*, 2014).

Phosphorus contents (68.31 mg/100g) obtained in this study was lower than the 410 mg/100g reported by Bassey *et al.* (2014) in RV leaves. It was however higher than the 25 mg/100g in RV leaves reported by Larbi *et al.* (1993). For other browse species, Bassey *et al.* (2014) reported the following phosphorus composition: 4.05 mg/100g in *Spondias mombin*, 2.90 mg/100g in *Manniophyton fulvum* and 260.00 mg/100g in *Palisota hirsute*. The following phosphorus concentrations are reported for these browses by Galindo *et al.* (2014): 0.28 mg/100g in fresh leaves of *Leucaena leucocephala*, 0.23 mg/100g in dried *Gliricidia sepium* leaves, 0.28 mg/100g in the leaves of *Azadirachta indica* and 0.24 mg/100g in dried *Moringa oleifera* leaves.

The iron (Fe) concentration of 0.23 mg/100g for RV leaves obtained in this study was lower than the 71.31 mg/100g reported by Bassey *et al.* (2014). For other browse plants, Bassey *et al.* (2014) reported these Fe concentrations: 0.68 mg/100g in *Spondias mombin*, 0.57 mg/100g in *Manniophyton fulvum* and 97.58 mg/100g in *Palisota hirsute*.

Sodium (Na) concentration of 128.16 mg/100g in RV leaves obtained in this research was higher compared to a concentration of 19.00 mg/100g reported by Bassey *et al.* (2014). The authors reported the following Na concentrations for these browse plants: 9.60 mg/100g in *Spondias mombin*, 6.40 mg/100g in *Manniophyton fulvum* and 15.00 mg/100g in *Palisota hirsute*.

Potassium (K) content of 47.93 mg/100g for RV leaves obtained in this study was lower than the 256.00 mg/100g reported by Bassey *et al.* (2014) in *Rauvolfia vomitoria* leaves. Potassium concentrations in other browses were 16.00 mg/100g in *Spondias mombin*, 12.80 mg/100g in *Manniophyton fulvum* and 192.00 mg/100g in *Palisota hirsute* (Bassey *et al.*, 2014).

The vitamins composition of *Rauvolfia vomitoria* leaves is as shown on Table 3.

Table 3: Vitamins composition (mg/100g) of *Rauvolfia vomitoria* leaves

Parameters	*Rauvolfia vomitoria* leaves
Vitamin A	18.82
Vitamin C	64.74
Vitamin D	41.62
Vitamin E	20.85
Vitamin K	13.36

Vitamin A concentration (18.82 mg/100g) obtained in this study was lower compared to the concentration of 236.78mg/100g in RV leaves reported by Okereke *et al.* (2015) but higher than the 1.44 mg/100g value in *Enterolobium cyclocarpum* leaves (Ekanem *et al.*, 2020). The

quantity of vitamin C in RV leaves (64.74 mg/100g) was higher than 0.57 mg/100g reported for RV leaves by Okereke *et al.* (2015) but lower than the 308.79 mg/100g in *Enterolobium cyclocarpum* leaves reported by Ekanem *et al.* (2020). Concentrations of vitamins D (41.62 mg/100g) and E (20.85mg/100g) obtained in RV leaves in this study were lower than the values of vitamin D (57.96 mg/100g) and vitamin E (22.18 mg/100g) reported by Ekanem *et al.* (2020).

The fibre fractions of *Rauvolfia vomitoria* leaves are as shown on Table 4.

Table 4: Fibre fractions (%) of *Rauvolfia vomitoria* leaves

Parameters	*Rauvolfia vomitoria* leaves
Neutral Detergent Fibre	62.91
Acid Detergent Fibre	39.00
Acid Detergent Lignin	15.25
Cellulose	23.75
Hemicellulose	23.91

Neutral Detergent Fibre (NDF) contents of 62.91 % in RV leaves obtained in this research was higher than the 53 % reported by Larbi *et al.* (1993) in RV leaves. Larbi *et al.* (1993) further reported the following NDF concentrations in these browse plants: 42 % in *Gliricidia sepium*, 46 % in Leucaena *leucocephala*, 50 % in *Alchornea cordifolia*, 36 % in *Baphia nitida*, 37 % in *Diallum guineensis*, 34 % in *Ficus capensis*, 52 % in *Glyphaea brevis*, 38 % in *Homalium aylmeri* and 40 % in *Manniophyton fulvum*. Ahamefule *et al.* (2006) also reported the following NDF contents in various browses: 43.50 % in *Tridax procumbens*, 69.50 % in *Aspilia africana*, 34.50 % in *Amaranthus spinosis*, 75.00 % in *Sida acuta*, 42.50 % in *Alchornea cordifolia*, 57.50 % in *Urena lobata*, 41.00 % in *Asystaia gangetica*, 33.00 % in *Manniphyton fulvum*, 64.00 % in *Calapogonium mucunoides*, 54.50 % in *Centrosema pubescens*, 52.00 % in *Landolphia owariensis*, 46.00 % in *Milletia spp.*, 36.50 % in *Grewia pubescens*, 59.00 % in *Dialium guinensis*, 48.00 % in *Combretum racemosum* and 39.00 % in *Napoleona vogelii*. The NDF in RV leaves was within the range reported for most browse plants.

The acid detergent fibre (ADF) content of 39.00 % in RV leaves obtained in this study was within the range reported for other browse plants: 34.70 – 41.28 % in *Gmelina arborea* (Ahamefule *et al.*, 2006; Okpara *et al.*, 2014), 19.26 – 32.00 % in fresh leaves of *Leucaena leucocephala* (Ogunbosoye, 2013; Galindo *et al.*, 2014), 34.80 % in dried leaves of *Leucaena leucocephala* (Asaolu *et al.*, 2012), 24.96 – 34.50 % in *Gliricidia sepium* (Asaolu *et al.*, 2012; Ogunbosoye, 2013; Oyedele *et al.*, 2016; Galindo *et al.*, 2014) and 20.10 – 79.90 % ADF reported by Ahamefule *et al.* (2006) in various browse plants. The percentage (15.25 %) of acid detergent lignin (ADL) in *Rauvolfia vomitoria* leaves was a bit higher than the range (6.00 – 14.96 %) reported for other browse plants (Aderinboye *et al.*, 2016; Ekanem *et al.*, 2020).

Table 5 shows the various anti-nutrients present in *Rauvolfia vomitoria* leaves.

Table 5: Anti-nutritional factors (mg/100g) in *Rauvolfia vomitoria* leaves

Parameters	*Rauvolfia vomitoria* leaves
Tannin	20.04
Saponin	3.61
Oxalate	128.96
Phytate	43.18
Hydrocyanic acid	15.78

The concentration of tannin (20.04 mg/100g) in RV leaves obtained in this study was higher than the 3.11 mg/100g reported by Bassey *et al.* (2014) in *Rauvolfia vomitoria* leaves, 1.63 mg/100g reported by Okereke *et al.* (2015) in RV leaves, but lower than 74.41 – 158.11 mg/100g tannin in differently preserved *Enterolobium cyclocarpum* leaves (Ekanem *et al.*, 2020). The concentration of saponin (3.61 mg/100g) in RV leaves obtained in this study was higher than the 1.52 mg/100g in RV leaves (Bassey *et al.*, 2014), but within the range of 3.18 – 4.49 mg/100g in *Enterolobium cyclocarpum* leaves (Ekanem *et al.*, 2020). Oxalate concentration of 128.96 mg/100g obtained for RV leaves in this study was lower than the value of 202.40 mg/100g in RV leaves reported by Bassey *et al.* (2014), lower than the 234.10 – 450.21 mg/100 in differently preserved *Enterolobium cyclocarpum* leaves (Ekanem *et al.*, 2020), but higher than the 0.18 mg/100g in RV leaves (Okereke *et al.*, 2015). Phytic acid concentration of 43.18 mg/100g obtained in this study was lower than 45.27 mg/100g in RV leaves reported by Bassey *et al.* (2014), lower than 1.35 mg/100g for RV leaves (Okereke *et al.*, 2015), but within the range of 2.51 – 89.90 mg/100g for differently preserved *Enterolobium cyclocarpum* leaves (Ekanem *et al.*, 2020). The 15.78 mg/100g concentration of hydrocyanic acid (HCN) obtained in RV leaves in this study was higher than 6.68 mg/100g HCN in RV leaves (Okereke *et al.*, 2015) but within the range of 4.50 – 19.96 mg/100g HCN in differently preserved *Enterolobium cyclocarpum* leaves (Ekanem *et al.*, 2020).

Higher concentrations of tannin and other ant-nutrients have proved very desirable in higher fecal nitrogen partitioning, retention, balance and reduced methane gas production in ruminant nutrition (Stewart, 2018, Ekanem *et al.*, 2020; Ekanem *et al.*, 2023a; Ekanem *et al.*, 2023b). Variations in nutrients composition of RV leaves obtained in this study with other reported variables may be due likely to plant species, eco-climatic zone, soil type, season of the year the leaves were harvested, stage of development, habit (shrub/plant), wilting/drying duration, preservation methods and method of analyses.

Conclusion

Rauvolfia vomitoria leaves are rich in proximate, minerals, vitamins, fibre fractions and anti-nutrients composition. These protein-dense forages rich in nitrogen free extract, vitamins and minerals will support optimal livestock growth and milk production. The fibre fractions and plant bioactive substances/anti-nutritional factors present in RV leaves will enhance effective rumen fermentation, absorption and retention of nutrients. These identified

nutrients and other unidentified chemical constituents of RV leaves will make it a veritable feed resource for the feeding of ruminant species.

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